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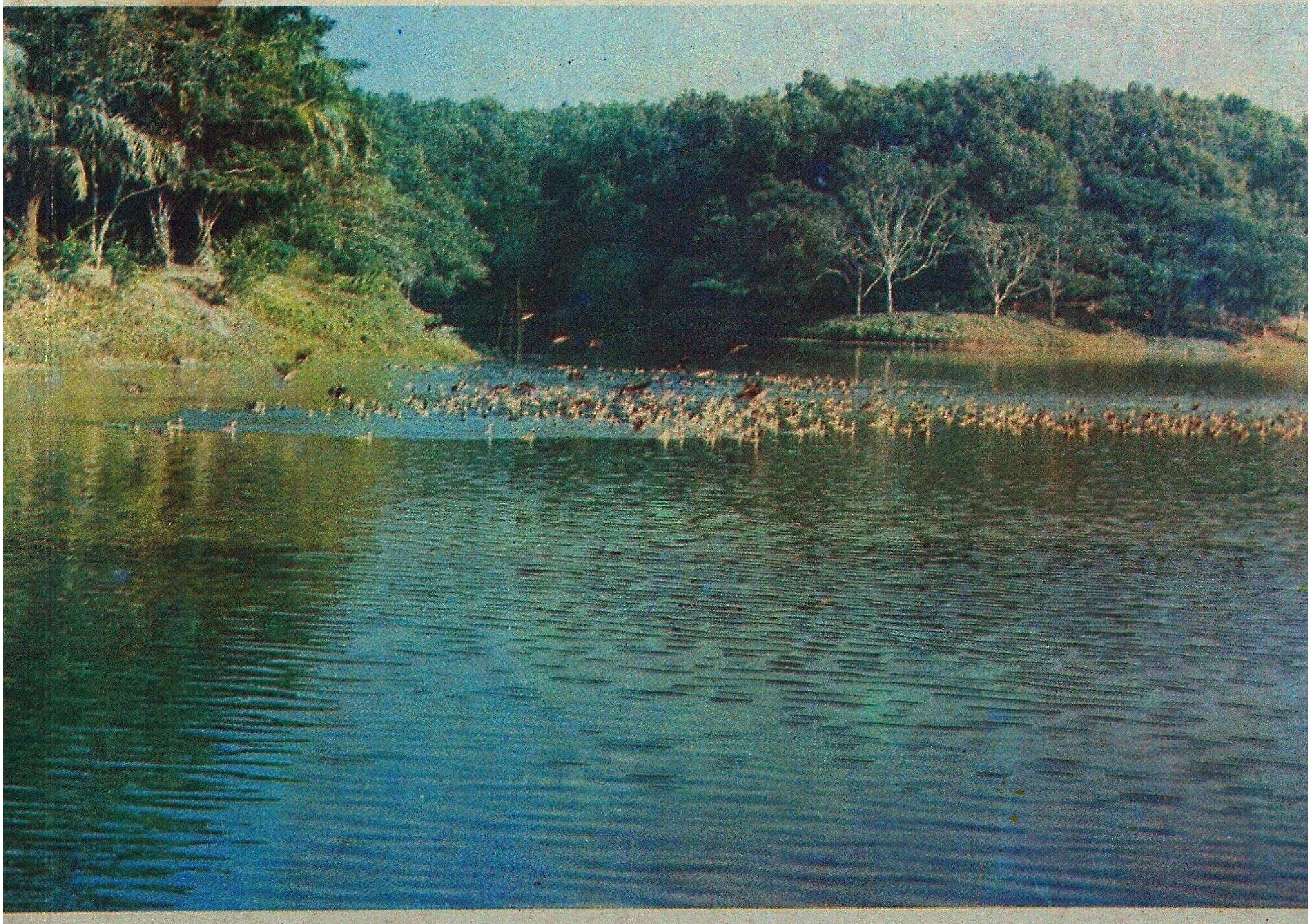

Focus on Biodiversity - II

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FRONT COVER

MIGRATORY BIRDS AT SEPAHIJALA WILDLIFE SANCTUARY, TRIPURA.
- Photo : D. Abhi

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BIODIVERSITY CONSERVATION IN THE THAR DESERT

ISHWAR PRAKASH*

Introduction

The Thar desert was mostly under the rule of Princes till Independence. The erstwhile Princes are often blamed of wanton killing of wildlife but the fact is that, almost all had created "Shikargah" which was open for shooting only to a few. It was otherwise a totally protected area. This is well proven by the fact that most of the present Wildlife Sanctuaries or National Parks in Rajasthan are the old "Shikargah" of erstwhile Princes. Some of them are also around clusters of villages of Bishnoi community which revere the trees and animals especially the black buck on religious grounds (Prakash and Ghosh, 1980). Moreover, the Thar desert is bestowed with extremely adapted grasses and shrubs which form highly nutritive feed for animals. With the low human population and a very difficult sandy terrain - without drinking water - the desert adapted trees and animals were safe from the human greed. The Thar desert was a haven for wildlife till Independence but after that as if hell had fallen and the commoners had a trigger-happy innings till 1972 when the Wildlife Preservation Act was formulated.

Faunal Diversity and Abundance in the Recent Past

A fuller description of diverse biota occurring in this desert would form a matter beyond the scope of this communication and, therefore, the presentation is restricted to birds and mammals of wildlife importance.

The Thar desert harbours a curious mixture of animals with Saharan affinities, highly adapted to xeric environment, and those spread all over India and even upto Malayan archipelago. Therefore, it exhibits a wide diversity of species and till recent past the abundance of some species was spectacular. In the nineteen fifties deep in the desert, I used to watch flocks of common Sandgrouse coming to the water point for a drink in the morning. For two hours, the flocks comprising of 5-10 thousand Sandgrouse, *Pterocles exustus*, landing and taking off from the village nadi. Nowadays the flock size had reduced to 25 to 75 birds per flock and only a few flocks visit the water point. Several water points are seldom visited. Similarly the flock size of the migratory winter visitor Imperial Sandgrouse, *Pterocles orientalis* has drastically diminished. During 1964 monsoon I was trapping rodents at Pali and joyfully watching at least 10 male floricans in a millet field of the size of 4 hectares, jumping above the crop level and displaying. Such sights are hard to see in the present times. During the same decade we observed 17 Great Indian Bustards, *Ardeotis nigriceps* in about 25 kms run in the vicinity of Pokhran. Today one has to go to the Desert National Park in Jaisalmer District for a hopeful sighting. The Houbara, *Chlamydotis undulatus* is likewise difficult to see as a very few migrate during the winter into the desert region (Prakash, 1974).

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A few mammals have vanished from the desert scene since the turn of the century.

The Lion, *Panthera leo* was distributed in the southern plains of the desert and the last Lion in Western Rajasthan was shot in South-western Rajasthan during 1870-1880 (Sheshadari, 1969). Blanford (1888-91) mentioned that they were still found in Southern Jodhpur and Mt. Abu region. The Cheetah, *Acinonyx jubatus* was fairly common in the vicinity of Jaipur (Sterndale, 1884). Likewise, the tiger was found on the Abu hills till 1930s. All these large carnivores have fallen victim of the trigger happy man and have vanished from the desert fauna. The medium sized carnivores have also suffered to a great extent, like the Caracal, *Felis caracal*, the Wolf, *Canis lupus*, the Jackal, *Canis aureus*. I used to watch the desert Cat, *Felis libyca ornata*, the desert Fox *Vulpes v. pusilles* behind almost every *Capparis* bush in 1950-60 but now their numbers have drastically dwindled (Prakash, 1975). As a result the predator pressure on herbivorous mammals is very low and resultantly, the number of several species of rodents has enhanced manifold (Prakash, 1975a) and they are inflicting severe damage to grasses, shrubs, trees and crops (Prakash and Ghosh, 1992).

In the recent past, the preponderance of ungulates was spectacular. The wild Boar, *Sus scrofa cristatus* were so common in the vicinity of Jodhpur town that in 1930s, it was not safe to move out from the houses in the hilly region as wild boars used to venture out even in the town streets, probably in search of food. Adam (1899) mentioned about the abundance of Black buck, *Antilope cervicapra rajputanae* that their herds were composed of thousands of heads. The wild Ass, *Equus hemionus*, now isolated only in the little Rann of Kutch, was found in Jaisalmer and Bikaner in fairly large herds (Jerdon, 1874). I have watched galloping Indian Gazelles, *Gazella bennetti*, in herds of 200-400 in the Sheo-Jaisalmer-Pokhran region during 1950s but now only pairs are seen, that too around Bishnoi villages (Prakash, 1974). The present situation is that one has to really search into the Thar desert to see a wild species in the wild. The glory of the Thar desert is all lost with the greed and development activities of man. It is a sad story! What are the major reasons for this gory drama which has been played in the Thar desert with its amazing faunal diversity?

The Biotic Pressure

The human and livestock population has registered a phenomenal upsurge in the Thar desert (Mann and Prakash, 1975) during the last few decades. The human population has escalated in Western Rajasthan from 3.4 million to 61.1 million in 1991. As a consequence cropping in marginal lands has increased thus reducing the grazing area by about 50 per cent. Besides human encroachment on rangelands, the human population is a serious stress on the vegetal resources, because of their need for fuel and fodder. Even the roots of a sand binder shrub *(Calligonum polygonoides)* are harvested. The 23 million livestock heads in Western Rajasthan have almost reversed the natural successional trends of vegetation (Saxena and Prakash, 1992). Most of the perennial, highly palatable and nutritive species have been replaced by inedible annuals. The ever-increasing numbers of livestock have deprived the wild herbivores of their natural food.

One of the other major reasons of loss of biodiversity in the Thar desert, especially of xeric species, is the expansion of irrigated agriculture. A fairly large number of tube wells and the mighty Indira Gandhi Canal are the prime sources of irrigation water. Irrigation by the canal has, and will, transform the grassland of Sewan (*Lasuirus sindicus*) into vast crop fields of rice, cotton, wheat, mustard with ample presence of human beings. The soil moisture regime has totally altered and is now unsuitable for the fossorial desert animals like the large predatory solifugid, *Galeodes agilis*, several species of Lizards *(Stenodactylus orientalis, Phrynocephalus laungowalensis, Ophiomorus tridactylus)*; Snakes *(Lytorhynchus paradoxus, Psammophis schokari, Sphalerosophis arenarius)* and Mammals (desert fox, desert cat, hedgehog *(Hemiechinus auritus collaris)*, Rodents *(Gerbillus nanus, G. gleadowi, Meriones hurrianae, Tatera indica)*. The Indian Gazelle, *Gazella bennetti* - which is still found in formidable numbers in the region are either migrating towards west or are becoming the target of the trigger-happy men (Prakash, 1992). The vanishing grasslands are no more suitable abode for the Great Indian Bustard *Ardeotis nigriceps* nor for the winter visitor Houbara, *Chlamydotis undulatus* and Imperial Sandgrouse, *Pterocles orientalis* and the Cinereus Vulture.

The avian faunistic composition is fast changing, replaced by birds found in the vicinity of water bodies (Soni, 1994). The typical desert species of rodents have been replaced by more harmful mesic elements like *Millardia meltada* and *Bandicota bengalensis* (Prakash, 1988). The transformation of the arid grasslands into extensive crop fields is influencing the faunistic composition of the Indira Gandhi Canal region, about 11 per cent of the Thar desert. The Gazelle is fast getting replaced by crop-deprading Blue bull, *Boselaphus tragocamelus*.

It is inevitable that with the upsurge of human population in the Thar, the face of the desert will change sooner or later. Many of the specialised forms of plants and animals associated with the Thar desert will eventually vanish. Should we not take measures to check this process? With the modern sophisticated technology available we must take steps to keep and maintain at least a part of the heritage with us for ever. Preservation of the whole desert ecosystem may be indeed very difficult but attempts have to be made so that the typical desert plants and animals of today are preserved and propagated for our future generation to admire and enjoy (Prakash, 1975a)

Pelt Trade : Trade for the skins has also taken a toll of antelopes and carnivores. This was mostly carried out by tribals and local tanners. During 1952-65, furred pelts of gazelle (for Rs. 5/- each), black buck (for Rs. 10/-), a stuffed head (for Rs. 20/-) were available with foot path sellers at Jodhpur. The skins of desert cat, desert fox, jackal, were being sold for Rs. 4-5/- only. Once I came across a full pelt of a well grown Siygosh *(Felis caracal)* which was being sold for Rs. 25/-. The tanner did inform me that he had bought the untreated skin from a Bawri for Rs. 5/-. The animal was collected around Jodhpur (November, 1962). Now *Caracal* has almost vanished from the Thar desert.

Biodiversity Conservation Measures

We must learn lessons; the enforcement of law during the ill-reputed Emergency proved to be a boon for the wildlife in the Thar. As a result of strict enforcement of law, the partridges are being seen everywhere, the gazelle and the black buck in the Thar desert were not so scared of the approaching Jeep during that period though they maintained a safe distance. Because of the forced recess from the hunters, small pockets of Wild boar, *Susscrofa cristatus* have emerged in IG Canal region and that of the Wolf, *Canis pallipes* in the Nokhamandi region and along the Luni river. Even the dampening of the will of Bishnoi community to protect the trees and the wildlife was strengthened. The unique Thar and adjoining regions are bestowed with Bishnoi - a solitary community in the world which religiously protects the wildlife (Prakash and Ghosh, 1980). It is high time to recognise and exploit this situation.

Translocation of Wildlife species : There are two situations in the Thar desert which warrant translocation of a species. Firstly around Bishnoi village complexes where black buck and gazelle have out-numbered the carrying capacity of the rangeland and have turned to food crops inflicting serious monetary losses to farmers. They have in a way assumed pest status. Secondly, from regions where their survival is threatened, like the IG Canal region where ecological conditions for the existence of typical desert animals have changed (Prakash, 1992). Unless serious thought is given to this problem, the desert animals will vanish with the increasing irri-agriculture. Preferably the translocation of larger mammals should be carried out into Bishnoi dominated areas, where these animals occurred in large numbers early in this century but have perished now. In the Western Rajasthan, ample regions fulfilling this requirement are available in Jalore, Pali, Nagour and Jodhpur districts. Before shifting animals, the techniques of tranquilising and transport should be perfected. The new region should be properly evaluated with regard to availability of fodder and grasses, and their safety. Translocation of larger mammals is a serious matter which requires adequate planning. Rejecting the idea of translocation for the fear of death of a few animals will further delay the matter and the wildlife numbers will dwindle to a point of no return. At present, we can afford to lose a few large mammals in this process.

Smaller National Parks : Fairly large areas in the IG Canal zone are, in fact, unsuitable for irrigation of crops, mainly because soil depth is very shallow and is lined by Murram layer (calcium carbonate). Flood irrigation, carried out 4-6 times in Rabi cropping season is likely to induce water logging, salinity and alkalinity development. Such lands should be declared National Parks and the land should be utilised for silvi-pastoral system along with plantation of top-feed trees. For this purpose, only drip irrigation should be adopted. Flood irrigation must be banned. The inter-row zones of top feed trees can be easily developed as a Sewan grass *(Lasiurus sindicus)* producing region. The top feed and grasses will constitute an extremely nutritive and highly palatable food for the artiodactyles and other herbivorous birds and animals (Prakash, 1992a). If a "real" protection can be given to these smaller national parks, especially from the grazing livestock, a natural ecological succession of primary, secondary producers and consumers will start and desert biota will be conserved *in-situ*.

Grazing Policy : At present, it is ones sweet will to keep as many goats, sheep, cattle, camel and other livestock and one can graze them anywhere and everywhere in the desert region. As a consequence, against the carrying capacity of desert rangelands of about 0.4 heads per hectare, the feed and fodder are being overgrazed by livestock ten times that of the sustainable resources. There is no law pertaining to grazing of livestock, 60 per cent of which has crossed the reproductive phase and are more or less useless as far as animal production is concerned. The severe competition for feed due to overgrazing by livestock has adversely affected the numbers and productivity of wildlife. The density of larger herbivores has dwindled and that of injurious small mammals like rodents has increased manifolds (Prakash, 1992a). There is an urgent need for formulation of a grazing policy in the desert. Proper staff for scientific and administrative work should be maintained with the responsibility of upgrading the productivity of ranges, and which should also regulate the quantum of grazing and monitor the feed-consumer relationship by deciding the number of livestock one can maintain *vis-a-vis* the carrying capacity of land. Without controlled grazing it is more or less futile to consider biodiversity conservation in the Thar desert.

Scientific Management of Protected Areas : A number of wildlife Sanctuaries and National Parks are existing in Western Rajasthan. These need to be managed on a scientific and ecological basis. At present, except patrolling the protected area, no action is being taken to enhance the primary productivity of the land, or for creating a computerised base line data on the biodiversity occurring in the sanctuary or the national park. Nor any attempt is being made to monitor and scientifically studying the plant and animal populations. It is high time that the animal numbers are adequately monitored so that effective remedial measures could be adopted for making the Sanctuary or National Park more "alive". The modern ecological researches can be entrusted to the nearest University (Prakash, 1975).

Captive Breeding of Threatened Species: By and large the management of several zoos has deteriorated as compared to what it was earlier - especially in Princely States. If the Bikaner and Jodhpur zoos - located in the Thar desert - can be transformed into breeding centres for threatened species, there will be, hopefully, no dearth of financial resource. As a consequence, the zoos will have an opportunity to be maintained in a most modern scientific style and part of it can be utilised for breeding of threatened species like the great Indian bustard, the florican, the desert carnivores, the black buck and the Indian gazelle. This proposition is not an easy one and would require a well trained staff, ecologists, endocrinologists, veterinarians for shaping the zoo into the breeding centre. The progeny should be released in proper re-introduction, well protected areas, where their survival is ascertained. This process will assist for a quick build up of the population of threatened species. It is high time that we learn lessons from wildlifers of other countries. We are losing ground.

The Thar desert is a future wildlife-bank in Southern Asia; we have only to take bold steps, we have to introduce "Science" in wildlife management.

Acknowledgements

Thanks are due to Dr. Q.H. Baqri for providing excellent facilities for my research work.

SUMMARY

The paper deals with the wildlife abundance as it was in the beginning of the present century. The Thar desert has already lost the lion, cheetah, caracal, wolf and wild boar. The population of florican, houbara, great Indian bustard, desert cat, desert fox, jackals, gazelle, black buck has drastically diminished. The causative factors of vanishing wildlife have been discussed. Irrigation through the water brought through the Indira Gandhi Canal is a mighty ecological event which is transforming vast desert grasslands into extensive crop fields. The typical xeric elements are being replaced by mesic species. Several measures for the conservation of biodiversity in the IG Canal region have been proposed which should be adopted without loss of time.

धार मरुभूमि में जैवविविधता का संरक्षण

ईश्वर प्रकाश

सारांश

यह अभिपत्र वन्यप्राणियों की प्रचुरता का, जैसी वह वर्तमान शती के आरम्भ में थी, विवेचन करता है । धार मरुसे सिंह, चीता, शशकर्ण, भेड़िया और जंगली सुअर पहले ही समाप्त हो चुके हैं । तृण मयूर, पश्चिमोत्तर सारंग, भारत महासारंग मरुबिडाल, मरुलोमड़ी, गीदड़, कुरंग, कृष्णसार की संख्या बहुत अधिक घट गई है । तेजी से घट रहे वन्यप्राणियों के कारणों का विवेचन किया गया है । इन्दिरा गाँधी नहर द्वारा लाया जा रहा सिंचाई जल बड़ी भारी पारिस्थिकीय घटना है जो मरुभूमि के विस्तृत घास क्षेत्रों को विस्तृत फसल उत्पादक खेतों में बदलती जा रही है । इसकी प्रारूपिक शुष्क जातियों का स्थान मध्य पादप जातियाँ लेती जा रही हैं । इन्दिरा गाँधी नहर क्षेत्र की जैवविवधता का संरक्षण करने के लिए कुछ उपाय सुझाए गए हैं जिन्हें बिना समय बरबाद किए जल्दी अपना लिया जाना चाहिए ।

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STUDIES ON FOREST ECOSYSTEMS DIVERSITY OF RAJAJI NATIONAL PARK, UTTAR PRADESH - IN A CONSERVATION PERSPECTIVE

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Introduction

Knowledge of flora and vegetation of any area is essential for the study of biodiversity and environment. Further in order to monitor and manage the protected areas like Sanctuaries, National Parks, Biosphere reserves a thorough knowledge of structural and functional aspects of various ecosystems is urgently required. With this objective, the studies on the varied tropical forest ecosystems of the Rajaji National Park in a conservation perspective were undertaken. Rajaji National Park formerly a Wildlife Sanctuary was established in 1979 for conservation of wild animals and plants *in-situ*. It is situated in the Siwalik Forest Division Uttar Pradesh between 77° 52' to 78° 22 E' and 29° 51' to 39° 15' N and has an area of approximately 820.40 km^2. It is bordered by Dehra Dun, Saharanpur Road running in North-east direction, the Khara-Hardwar road in the South-west, the Laksar-Dehra Dun and Siwalik Forest Division in the north-east (Fig. 1). The entire area forms the south-eastern steep slopes of the Siwalik hills stretching in south-eastern direction between River Yamuna in the north-west and Ganga in the South-east. The park is inhabited by approximately 512 nomadic Gujars who have been living inside the park for centuries (Fig 2). They are well acquainted with various forest ecosystems of the park. They are cattle graziers who live in the forests with their herds of buffaloes. Although they are Muslims they are vegetarians and never harm wild animals. They partly depend on the forest for meeting their fuel and fodder needs. The Park is a centre of attraction to visitors, botanists, naturalists, wild life experts and ecologists. The rich and diverse vegetation supports diverse fauna which is represented by animals like Tiger, Panther, Wild Cats, Hyaena, Hog Deer, Barking Deer, Spotted Deer, Sambhar, Wild Elephants, Monkey, Hairs, Bear, Nilgai, Wildboar, Jackals, Fox, Langoor, Squirrels, Rats, Karait, Python, Porcupine etc. living in different forest ecosystem and interacting with plants. The forest types and plants of the area have been studied and compared with the previous works (Champion and Seth, 1968; Duthei, 1903-1929; Babu, 1977; Singh and Maheswari, 1984; Uniyal and Rao, 1993).

Geology, Soil and Climate

Topography is extremely rugged with several sharply dissected hills due to human influence. There are numerous steep and

Fig. 1

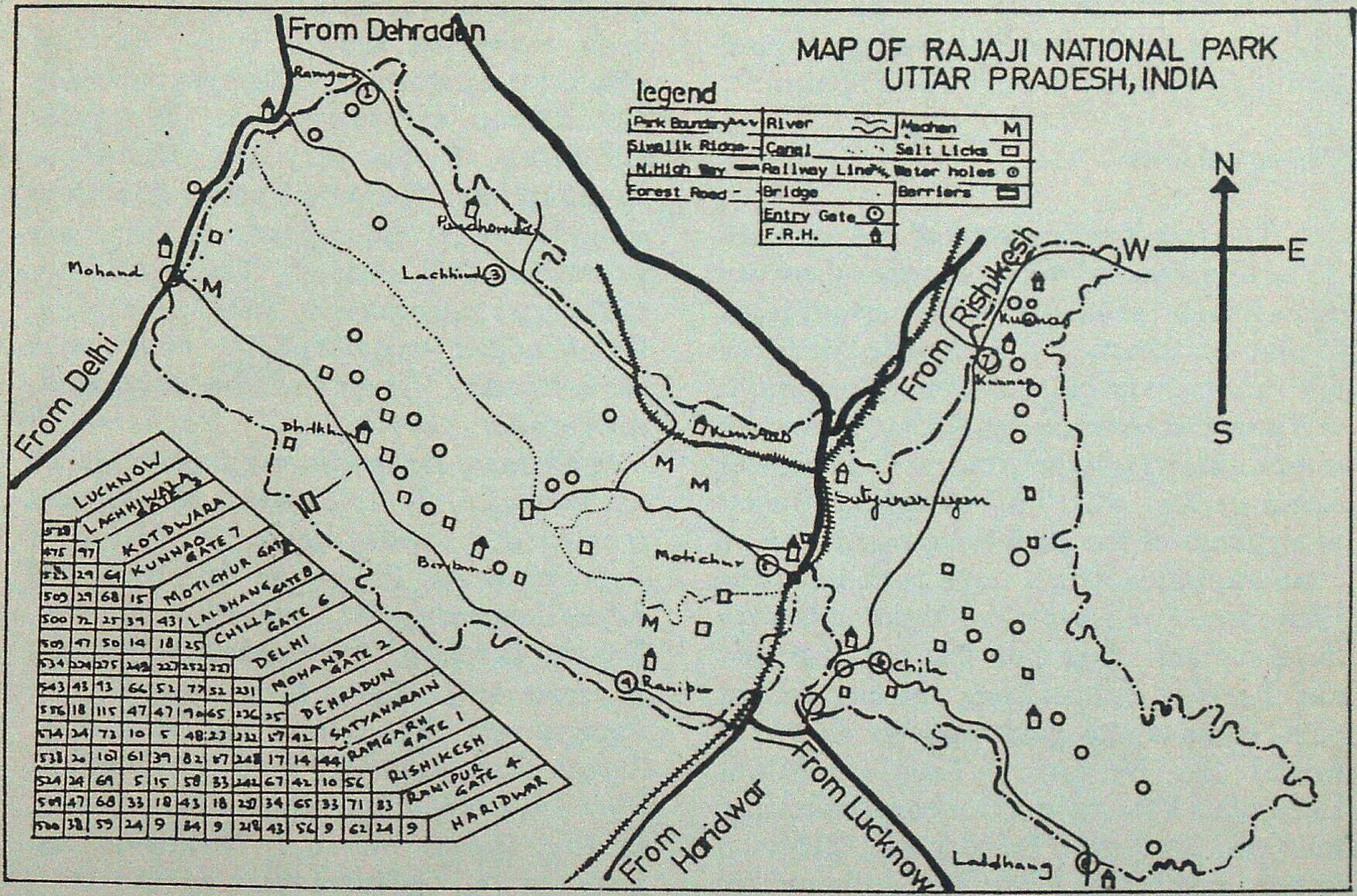
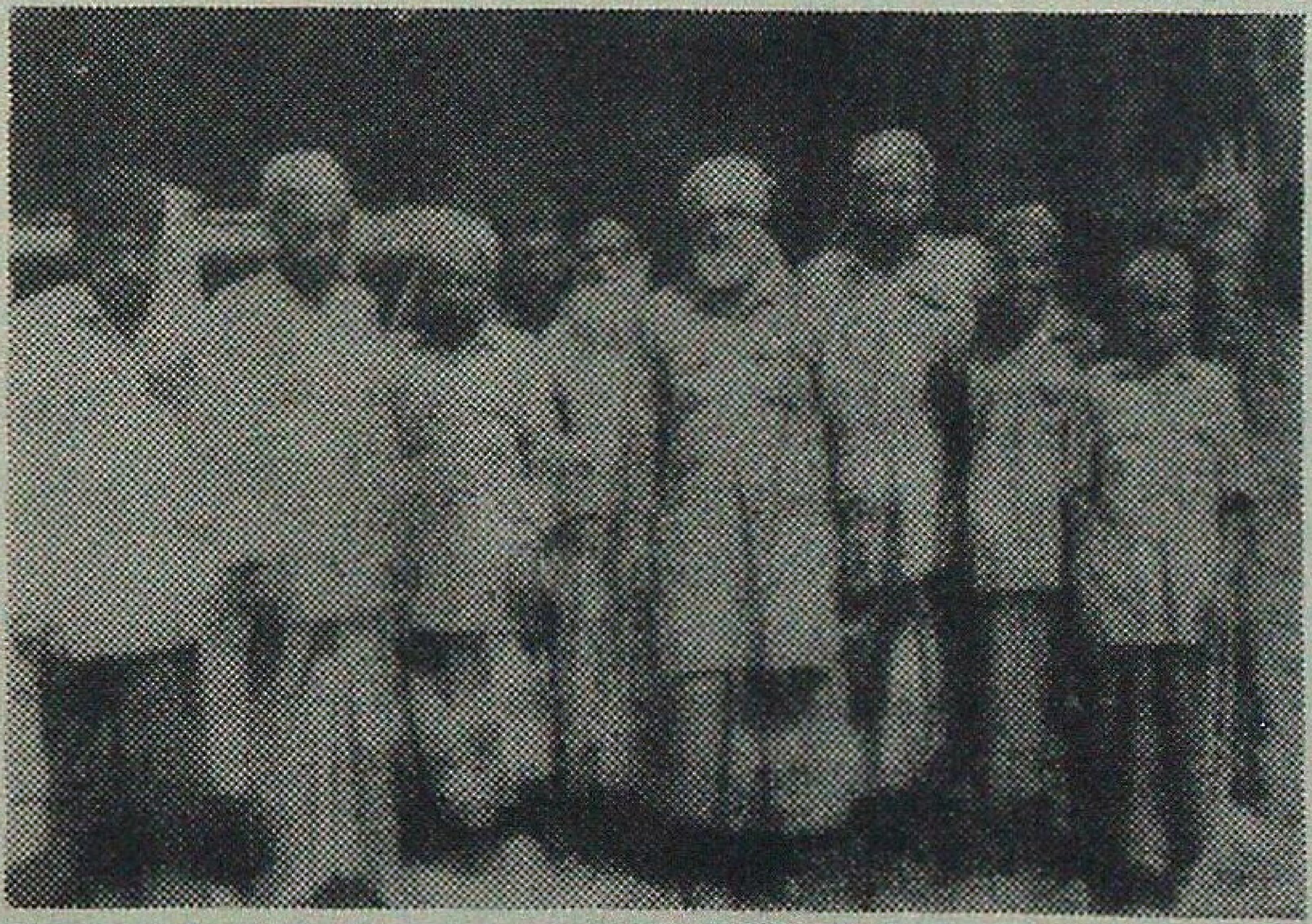

MAP OF RAJAJI NATIONAL PARK
UTTAR PRADESH, INDIA
legend
Park Boundary
River
Machan M
Siwalik Ridge
Canal
Salt Licks
N. High Way
Railway Line
Water holes
Forest Road
Bridge
Barriers
Entry Gate
F.R.H.
N
S
W
E
From Dehradun
Ramgarh
Mohand
Lachhiwala
From Delhi
Dholkhand
Kunnao
From Rishikesh
Satyanarayan
Motichur
Ranipur
Chila
From Haridwar
From Lucknow
Laldhang
LUCKNOW
LACHHIWALA GATE 3
KOTDWARA
KUNNAO GATE 7
MOTICHUR GATE
LALDHANG GATE 8
CHILLA GATE 6
DELHI
MOHAND GATE 2
DEHRADUN
SATYANARAIN
RAMGARH GATE 1
RISHIKESH
RANIPUR GATE 4
HARIDWAR

Fig. 2



Nomadic Gujjars of Dholkhand Range of the Park.

precipitous slopes all over the park. The altitude varies between 250m to 900m and at some places the variation is rather abrupt. The land slope is marked by steep gorges and gullies, which cut through the unconsolidated strata, that forms the floor of these valleys.

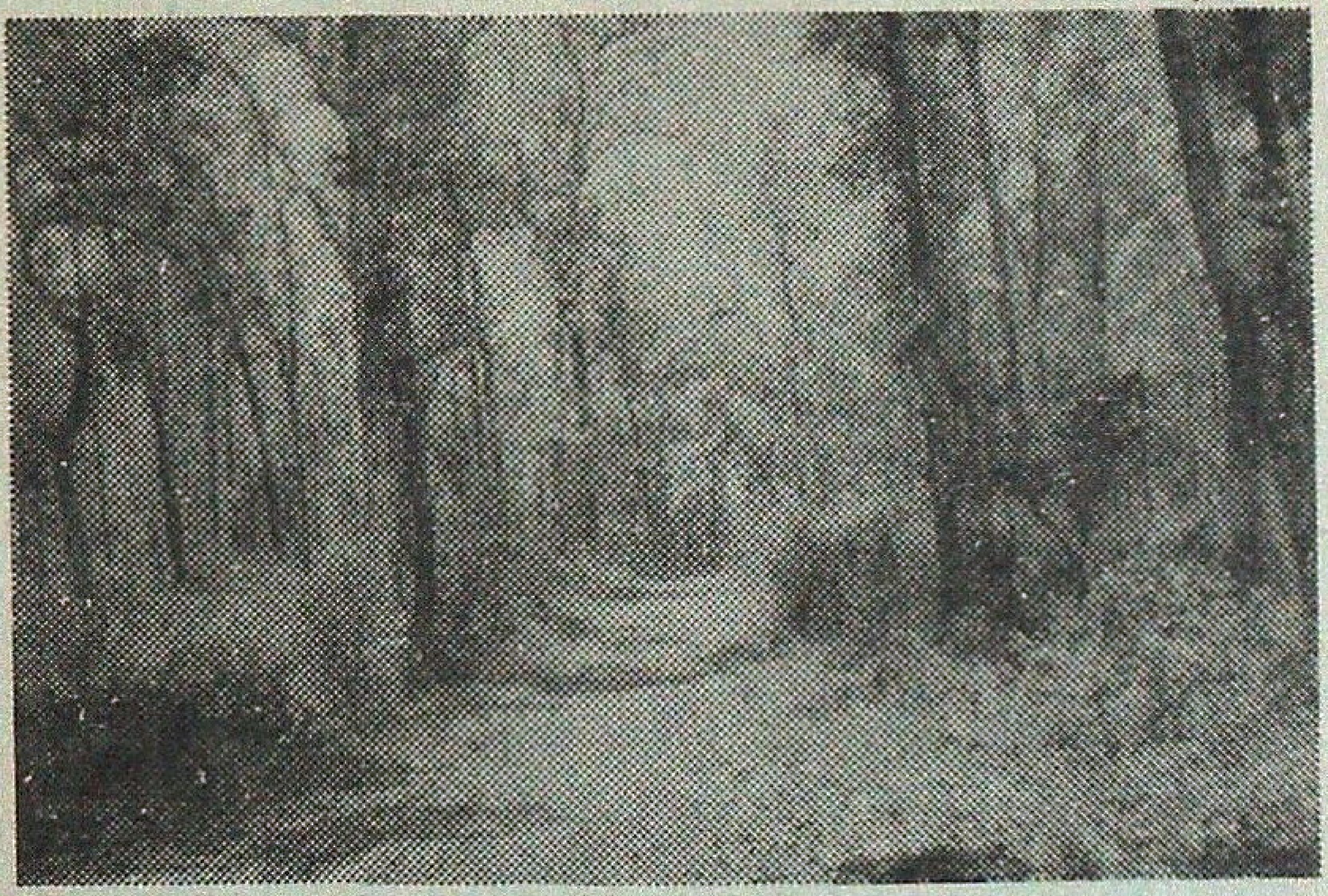
The soil is very poor and consists of beaos of sand stone, gravel and conglomerates. The torrent beds which are distinctive features of the area for most part of the year remain dry but are active during rainy season when they carry a large amount of debris often causing considerable damage to the vegetation of the area. These torrential beds are locally known as 'Raus'. The climate of the Park is rather extremes of high rainfall, high humidity and high temperature which have favoured a rich tropical moist type of vegetation. May and June are the hottest months with temperature reaching upto 40 or 41°C and December to January are the coldest months with temperature below 2°C. July to September are monsoon months with heavy down pour. The average annual rainfall is approximate 2000-2200 mm.

Observations

The forest ecosystems of the park are quite varied and diverse. A general survey of the forests revealed some important types of plant association like *Shorea, Mallotus* and *Adina* community, *Shorea, Terminalia* and *Bridelia* community; *Dalbergia, Acacia* community; *Syzygium, Phoebe* and *Drypetes* community etc. The tropical forest ecosystems of the park have many unique characteristics which have both scientific importance and practical significance for development. Based on the physiognomy and floristic composition, the permanent vegetation of the park may be classified under the Northern Tropical Moist Deciduous Forests and can be grouped into following six types: (1) Sal forest, (2) Mixed forest, (3) Riverine forest, (4) Scrubland, (5) Grassland (Savannah), (6) Sub-tropical Pine forest.

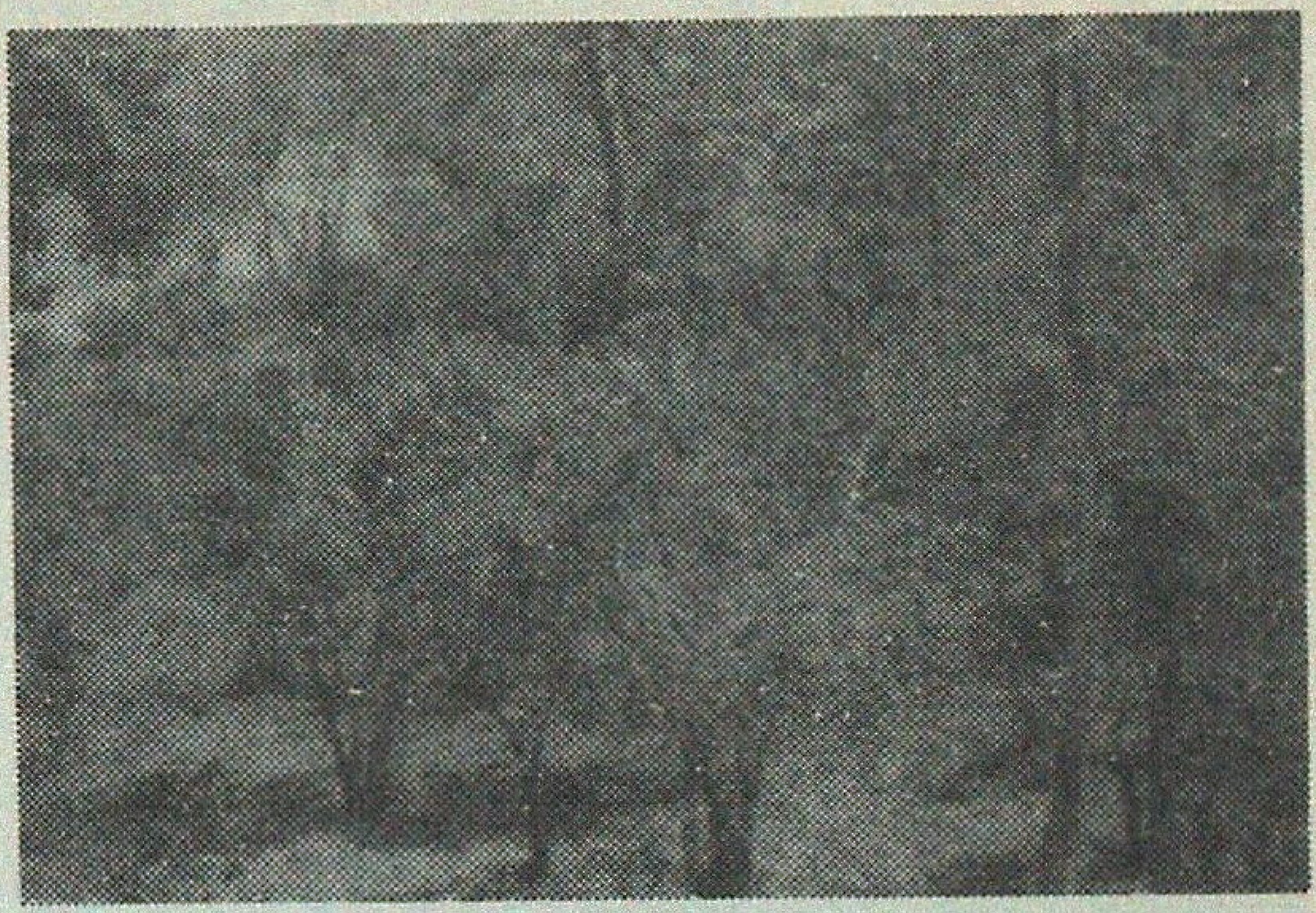
Sal forest : It occupies major part of the park and are of two types namely Tropical Moist Decidous and Tropical Dry Deciduous type. The Tropical Moist Deciduous type is represented by the dominant trees species *Shorea robusta* which forms pure belts and can be easily distinguished in various storeys of the forest. The common associates of Sal forest are *Terminalia alata, Anogeisus latifolia, Adina cordifolia, Terminalia bellirica, Lannea coromandelica, Garuga pinnata, Stereospermum chelonoides, Ougeinia oojeinensis, Cassia fistula, Bridelia squamosa, Lagerstroemia parviflora, Scheleichera oleosa, Semecarpus anacardium, Buchanania lanzan, Careya arborea, Mallotus philippensis etc.* The middle storey consists of chiefly species like *Aegle marmelos, Ehretia laevis, Emblica officinalis, Cassia fistula, Syzygium cumini, Holarrhena antidysenterica, Diospyros exsculpta, Kydia calycina, Bauhinia variegata* etc. The forest under growth is composed of *Ardisia solanacea, Flemingia strobilifera, E. chappar, Carissa opaca, Callicarpa macrophylla, Murraya koenigii, Colebrookea oppositifolia, Glycosmis mauritiana, Clerodendrum viscosum, Adhatoda zeylanica, Pogostemon benghalense, Desmodium gangeticum, D. heterocarpon, D. velutinum, Woodfordia fruticosa, Indigofera cassioides, Leea crispa* etc. The gound flora consist of *Adenostemma lavenia, Curculigo orchioides, Uraria lagopus, Acrocephalus indicus, Blumea* spp., *Ageratum conzyzoides, Cyperus* spp. *Polygonum* spp., *Sida* spp., *Aerua sanguinolenta, Solanum viarum, Vernonia cinerea, Ajuga bracteosa, Hemigraphis hirta, Hackelochloa granularis, Opliasmenus compositus, O. burmanii, Cyrtococcum patens, Hibiscus lobatus, Crotalaria sericia, Siegesbeckia orientalis, Urena lobata, Cynoglossum lanceolatum, Biophytum sensitivum* etc. The common climbers met in the forest are *Acacia pennata, Caesalpinia bonduc, Hiptage benghalensis, Clematis gouriana, Vallaris solanacea, Capparis zeylanica, Tinospora cordifolia, Aspidopteris wallichii, Porana paniculata, Smilax* spp., *Bauhinia vahlii, Ventilago denticulata, Ziziphus oenoplia, Pueraria tuberosa, Millettia extensa, Abrus precatorius, Ichnocarpus frutiscens, Celastrus paniculatus, Ampelocissus latifolia, Cissapelos pariera, Butea parviflora, Disocorea bellophyla, D. bulbifera, Coccinia grandis, Cryptolepis buchanani, Combretum decandrum, Scindapsus officinalis* etc. (Fig. 3).

Fig.3



Sal forest of the Park

Fig.4



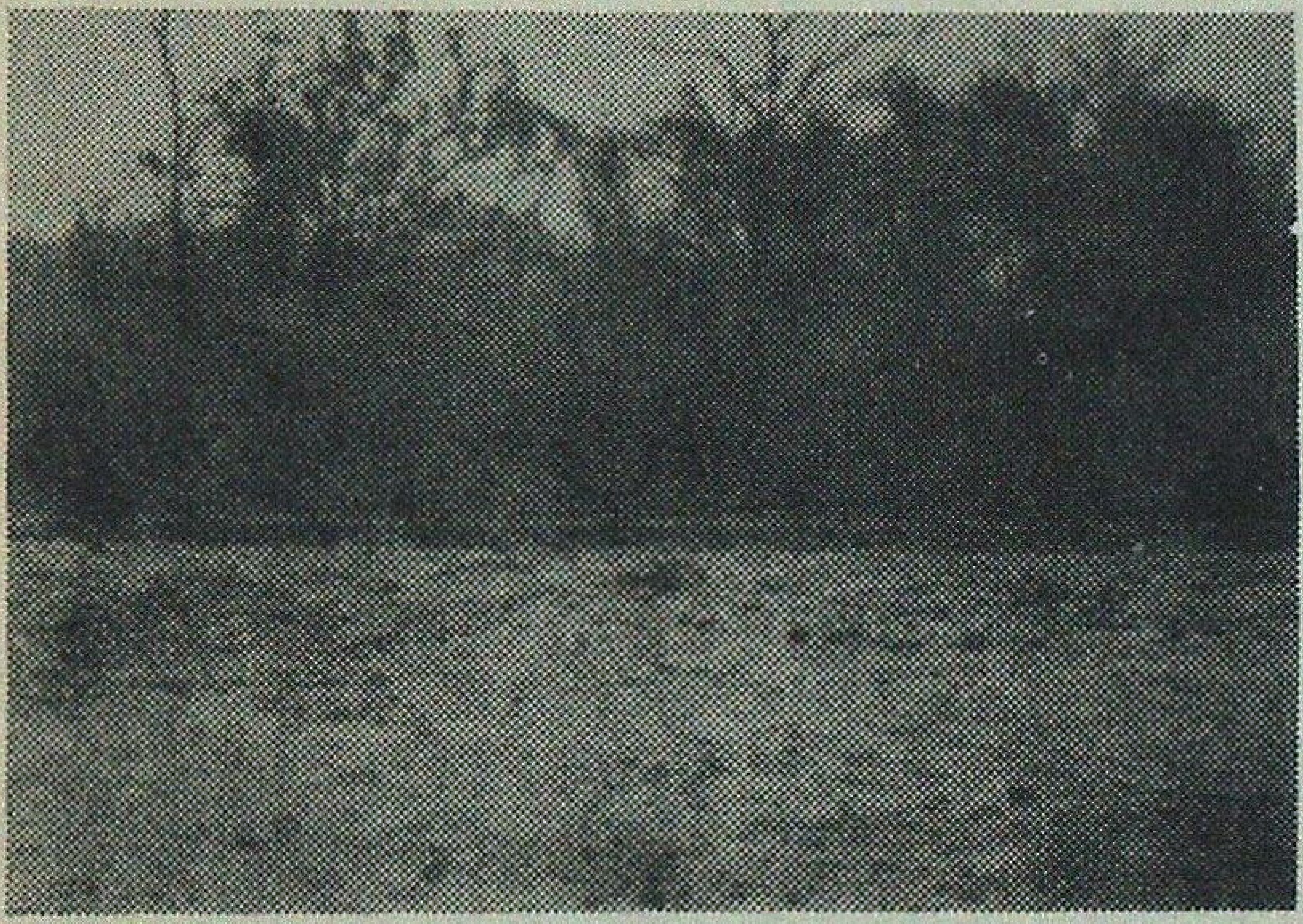
Mixed forest of the Park

Mixed forest : The common species found in these forest are *Anogeissus latifolia, Albizia procera, A. labbek, Boehmeria rugulosa, Lannea coromandelica, Terminalia bellirica, Mallotus philippensis, Wendlandia heynii, Bombax ceiba* etc. The middle storey consist of trees like *Acacia catechu, Hymenodycton excelsum, Mitragyna parvifolia, Aegle marmelos, Garuga pinnata, Erythrina suberosa, Casearia elliptica, Ailanthus excelsa, Emblica officinalis, Bridelia squamosa, Gmelina arborea, Kydia calycina, Litsea glutinosa, Trewia nudiflora, Ehretia laevis, Cassia fistula, Sterculia villosa, Ziziphus xylopyrus, Z. mauritiana, Butea monosperma* etc.

The common shrubs of these forest are *Carissa opaca, Adhatoda zeylanica, Colebrookea oppositifolia, Leea crispa, Murraya koenigii. Calotropis procera, Clerodendrum viscosum, Woodfordia fruticosa,* The common grasses found in these forests are *Apluda mutica, Heteropogon contortus, Eulaliopsis binata, Hackelochloa granularis, Chrysopogon fulvus, Oplismenus compositus, Setaria glauca, Imperata cylindrica* etc. The climbers like *Ampelocissus latifolia, Tinospora cordifolia, Cissampelos pariera, Ventilago denticulata, Ichnocarpus frutecens* are also seen (Fig. 4).

Riverine forest : The vegetation occurring in low lying water logged areas, along nalas, river beds and streambeds develops into a riverine forest. The type consists of an irregular forest of mainly evergreen species which are able to withstand the wetness of the occupied sites. The common species of these forest are : *Syzygium cumini, Ficus racemosa, F. semicordata, Bischofia javanica, Trewia nudiflora, Pterospermum acerifolium, Albizia procera, Toona ciliata, Calamus tenuis* etc. The under wood consist of *Diospyros exsculpta, Phoebe lanceolata, Machillus gambeli, Salix tetrasperma, Cudrania javanica* etc. The undergrowth consist of *Ardisia solancaea, Achronysia pedunculata, Desmodium labernifolium, Vetiveria zizanioides* and many fern species. Some common herbs are *Eclipta alba, Centella asiatica, Corchorus* spp., *Bupleurum hamiltoni, Youngia japonica, Mazus pumilus, Lindenbergia* spp, *Rungia pectinata, Hemigraphis hirta* etc. The common climbers are *Vallaris solancea, Combretum decandrum* etc. The vegetation along river streams and nala consists of species like *Trewia nudiflora, Syzygium cumini, Dalbergia sissoo, Orthanthera*

Fig.5



Riverine forest of the Park

viminea, Xylosma longifolia, Adhatoda zeylanica, Gonostegia pentandra, Globba racemosa, Hartamania roses etc. (Fig. 5).

Scrub forests : These forests represent a degradation stage of Dry Deciduous Forests which are formed as a result of adverse biotic factors like over grazing, lopping, felling and fires etc. The trees growth are stunted. The main trees species found are *Aegle marmelos, Lannea coromandelica, Sapium insigne, Erythrina suberosa, Cassia fistula, Flaucortia indica, Ziziphus mauritiana, Z. xylopyros* etc. The common shrubs are *Nyctanthes arbortristis, Woodfordia fruticosa, Lantana camara, Carissa opaca, Xeromphis spinosa, Murraya koenigii, Colebrookea oppositifolia, Adhatoda zeylanica, Ziziphus oenoplia, Z. nummularia*, etc.

Savannah or Grassland : The savannah are not climax in the park, but have developed only due to disturbance of the natural flora. These are characterised by grasses like *Themeda arundinacea, T. villosa, Aplude mutica, Desmostachya bipinnata, Phragmites karka, Cympopogon flexuosus, Digitaria* spp., *Eragrostis japonica, E. tenella, Eulaliopsis binata, Heteropogon contortus, Setaria* spp., *Vetiveria zizanioides* etc. The grassland are interspersed here and there with some trees and shrubs like *Ailanthus excelsa, Butea monosperma, Bombax cieba, Acacia catechu, Dalbergia sissoo, Mitragyna parvifolia, Syzygium cumini, Calotropis procera, Helicteres isora, Carissa opaca, Ziziphus xylophyrus, Woodfordia fruticosa* etc. The common bamboo *Dendrocalamus strictus* forms gregarious patches at many places of the Park. The association of *Acacia-Dalbergia* community consists mainly species like *Acacia catechu* and *Dalbergia sissoo* in the form of pure patches occurring in some parts of the park. The undergrowth of this type is thin and consists of species like *Lantana camara, Adhatoda zeylanica, Murraya koenigii, Zyzyphus* sp., *Clerodendrum viscosum, Cassia tora, C. occidentalis* etc.

Sub-tropical Pine forest : It occurs along with Dry Deciduous Mixed Forest and Sal forest. The area covered by this type is very small. Chir (*Pinus roxburghii*) occurs on higher slopes of Siwalik, mixed with stunted Sal forest. The other associates of Pine are *Anogeissus latifolia, Terminalia alata, Buchanania lanzan, Terminalia bellirica, Stereospermum chelonoides, Ougeinia oojeinensis, Grewia elastica, Nyctanthes arbortristis, Mallotus philippensis* etc. The undergrowth is generally poor consisting mainly of *Carissa opaca, Ziziphus xylopyrus, Woodfordia fruticosa, Indigofera cassioides, Tephrosia candida, Colebrookea oppositifolia* etc. The common grasses and *Eulaliopsos binata, Crysopogon fulvus, Andropogon controtus* etc.

Factors affecting the vegetation

A number of biotic and abiotic factors have been found to influence the vegetation and floristic composition of the forest ecosystems. These are :

Fire : Fire is by far the most serious factor affecting the forests of the Park. It causes severe damage to the herbaceous flora and young saplings of various trees. In many cases, fires that occur are incendiary, caused by graziers interested in getting fresh clumps of grasses for the cattle. It has, however, been commonly observed that species like *Pygmaeopremna herbacea* (Roxb.) Moldenke, and *Curcuma angustifolia* Roxb. begin to appear on the burnt ground.

Flood : Floods cause severe damage to the vegetation of the Park. The Gnaga river, Song river and *nalas* are overflooded during and sometimes after the rains, which inundate a major portion of the forest areas and cause considerable damage to the vegetation.

Browsing and grazing : Grazing by domestic animals causes much injury to the ground flora. The wild animals like elephants, pigs, spotted deer. etc. cause damage to the forests by grazing and browsing the young twigs, branches and tubers. During the summer season, the intense heat spell is generally followed by wind storms for few days with occasional thunder showers. The velocity of wind storm is sometimes so high that it uproots the trees and shrubs. The worst damage is, however, caused by the storm in destroying the flowers and immature fruits. The forests are also being continuously lopped for fodder and fuelwood by the villagers.

Weeds and pests : The forests are infested by a large number of climbers and liana that cause great damage to the valuable timber trees. These climbers reach almost to the top of the forest canopy and hamper proper growth of young trees and shrubs. the parasitic plant like *Dendropthoe falcata* (Linn.f.) Ettings., and *Cuscuta reflexa* Roxb., are found on a wide range of host trees like *Adina cordifolia* (Roxb.) Hook. ex Brandis, *Bombax ceiba* Linn., *Xeromphis spinosa* (Thunb.) Keay, *Ziziphus xylopyrus* (Retz.) Willd., *Z. mauritiana* Lamk. etc. and cause considerable damage to the forests. Besides, there are a large number of parasitic fungi and insects causing severe damage to Sal and other economic plants of the forest.

Plant-animal interaction

A variety of wildlife is represented in different forest ecosystems of the Park. The rich vegetation offers a stable source of food to a number of herbivores. Some important wildlife like *Panthera tigris* (Tiger), *Felido panthero, F. pantheropardes* (Guldar), *F. chaus* (Jangli billi), *Heynaea heynasa* (Lakarbagga), *Elephas maximus* (Hathi), *Hystrix indica* (Sahi), *Lagus nigeicolis* (Khargosh), *Macaca mullata* (Bandar), *Presbytis entallus* (Langur), *Hobhorhida garol* (Ghural), *Axis axis* (Chital), *Muntiacus muntjak* (Kakar), *Cervus unicolor* (Sambhar), *Suscrofa cristan* (Jangli suar), *Tatraceras guadi* (Chosingha), *Canis aureus* (Siyar), *Vulpes bengalensis* (Lomadi), *Basilops tragocamalus* (Nilgai), *Herpestas edwardii* (Neola), *Varanus benghalensis* (Goh), *Naja naja* (Cobra), *Vipra russalli* (Karait), *Python reticulatus* (Ajgar), several birds and fishes etc. are commonly found in the forest ecosystems interacting with the plants.

The herbivorous animals feed on many trees, shrubs, herbs and grasses for their food requirement. They prefer the leaves, barks, twigs, flowers, fruits and seeds of species like *Mallotus philippensis*,

Dendrocalamus strictus, Dalbergia sissoo, Acacia catechu, Adina cordifolia, Albizia lebbek, A. procera, Aegle marmelos, Atylosia spp., *Rhynchosia minima, Ageratum conzynoides, Aplunda mutica, Bauhinia purpurea, Bombax ceiba, Careya arborea, Desmodium* spp., *Cassia fistula, Cynodon dactylon, Ficus benghalensis, F. racemosa, F. religiosa, F. semicordata, Garuga pinnata, Hesperethusa crenulata, Kydia calycina, Heteropogon contortus, Ongeinia oojeinensisea, Lannea coromandelica, Phragmites karka, Arundo donax, Shorea robusta, Syzygium cumini, Tinospera cordifolia, Terminalia alata, T. bellirica, Ziziphus mauritiana* etc. The wild elephants prefer to feed the bark and leaves of species like *Ficus benghalensis, F. religiosa, F. racemosa, F. semicordata, Mallotus philippensis, Dendrocalamus strictus, Ougeinia oojeinensis, Boxbax ceiba* etc. and cause considerable damage to the forests.

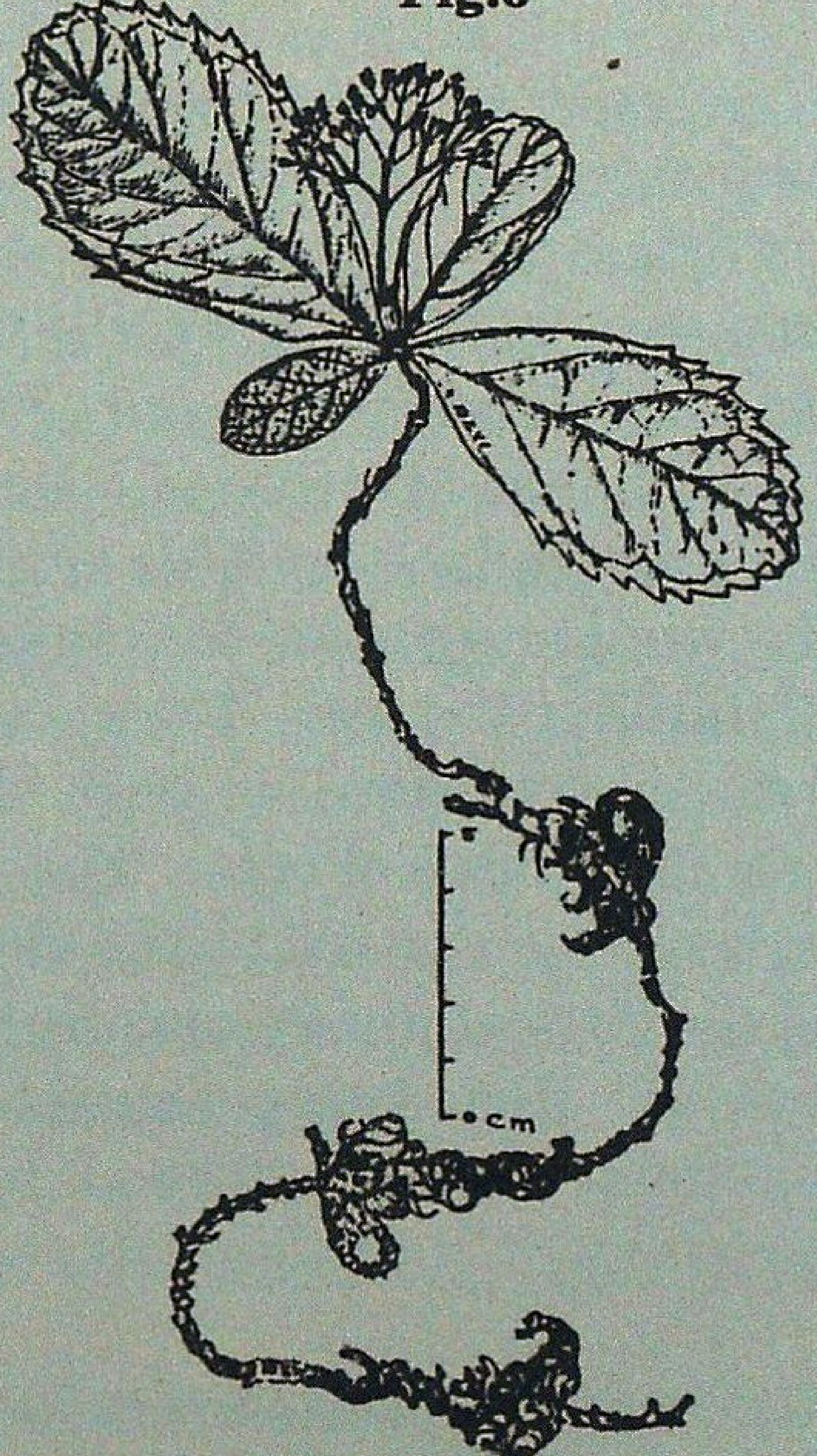
The Deer, Monkey, Langoor, Rats and Hares feed on wild fruits of plants like *Ficus* spp., *Terminalia bellirica, Buchanania lanzan, Ehretia laevis, Aegle marmelos, Syzygium cumini, Schleichera oleaca, Emblica officinalis, Cordia dichotoma, Carissa opaca, Dalbergia sissoo, Lantana camara, Grewia hirsuta, Diospyros exsculpta, Ziziphus mauritiana* etc. and help in dispersal of fruits and seeds of these species in the park. Besides, several birds, insects and bees help in pollination and dispersal of seeds of various plant species.

Domisticated animals also feed on these species and help in dispersal of fruits of species like *Xanthium strumarium, Achyranthes aspera, Pupalia lappacea, Tribulus terrestis* etc. in the Park.

Conservation

The habitat loss due to modernisation, over-grazing, animal husbandry, wildlife and tourism has resulted in the loss of biodiversity. Equally important are the lack of trained manpower to monitor the diversity, high exploitation of the medicinal and economic plants, public awareness towards the significance of biodiversity, and lack of financial support for undertaking conservation programmes. The natural causes like floods, earthquake, landslides also add to this tragedy. Endangered species have particularly suffered from lack of effective pollinators, viable seed formation, and natural regeneration, diseases etc. resulting in the depletion and erosion of the genetic diversity in them. It is estimated that nearly 1500 species of flowering plant species of Indian flora are endangered to various degrees.

Fig.6



Pygmaeopremna herbacea (Roxb.) Moldenke - a rare and threatened plant

No conservation strategy can be effective unless it takes care of the basic needs of the local communities. A good deal of biodiversity is also protected through folk traditions. Conservation of biota encompasses a whole spectrum of activities from *in-situ* conservation dealing with conserving biota in their natural habitats and biosphere reserves on the one hand, and on the other it deals with *ex-situ* involving preservation of the biota in botanic gardens, arboreta and even in biological banks such as storing pollen, seeds, tissue, organs and genes. The establishment of Rajaji National Park is a right step in promoting *in-situ* conservation of wild animals and plant genetic resources at the Government level.

Considering the prevailing situation and diverse plant wealth of the park emphasis is laid on the conservation measures both *in-situ* and *ex-situ*. The *in-situ* approach however needs priority for the protection of endangered species which have already lost the diversity and are not able to adjust. For effective conservation of forest biodiversity *in-situ*, preservation plots in different forest ecosystems can be established. Preservation plots are precise examples of local level management norms for biodiversity plots as "demarcated forest areas set aside in perpetuity for the preservation of the forest with no human interference beyond what is necessary for their protection and maintenance". The preservation plots serve as "ecological reference centre or ecological labs" for studying natural ecological processes in isolation from human interference and pressure, thus dealing with wise management of biodiversity. Researches on various ecological habitats of endangered species should also be undertaken. Afforestation of fuel and fodder species under Social Forestry programmes may be encouraged in the surrounding areas so that the pressure on the protected forest is checked. Studies on the reproductive behaviour and populations dynamics of threatened and rare species should be carried out over a period of time *in-situ*. The park managements should initiate a program or develop a strategy to examine conservation status of vegetation, communities, habitats and species that are threatened and need protection.

The species like *Mitreola petiolata, Pygmaeopremna herbacea,* (Fig. 7) *Primula umbellata, Costus speciosus, Eremostachys superba, Catamixis baccharoides, Euphorbia fusiformis, Urginia indica, Rauvolfia serpentina* having restricted distribution and scarce population in the park are threatened and need *in-situ* and *ex-situ* conservation.

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SUMMARY

Rajaji National Park is situated in the Siwalik Forest Division, Uttar Pradesh and has an area of approximately 820.40 km^2. The diverse forest ecosystems of the park provide an ideal habitat for many wild animals. The forests are classified under the Northern Tropical Moist Deciduous types having varied and diverse ecosystems. A general survey of the forests revealed some important types of plant associations like *Shorea, Mallotus* and *Adina* Community; *Shorea-Terminalia* and *Bridelia* community - *Syzygium, Phoebe* and *Drypetes* community etc. Based on the physiognomy and floristic compositions, the forests may be grouped into six types namely (1) Sal forest, (2) Mixed forest, (3) Riverine forest, (4) Scrubland, (5) Grassland (Savannah), (6) Sub-tropical Pine forest. The dominant tree species *Shorea robusta* Gaertn.f. forms pure belt of Sal forest in major part of the park. Factors affecting the vegetation and plant-animals interaction have been given in this paper. The diverse tropical ecosystems of the park have many unique characteristics which have both scientific importance and practical significance for overall ecodevelopment. Discussing the depleting plant resources, the possible causes and effective measures for conservation of threatened species are provided in this paper.

राजाजी राष्ट्रीय उपवन, उत्तरप्रदेश की वन परिस्थिति-संहति की विविधता का संरक्षण परिप्रेक्ष्य में अध्ययन

के० के० सिंह व आनन्द प्रकाश

सारांश

राजाजी राष्ट्रीय उपवन उत्तरप्रदेश के शिवालिक वन मण्डल में स्थित है और इसका क्षेत्रफल लगभग 820.40 वर्ग किलोमीटर है। इस उपवन की विविध वन परिस्थिति-संहति बहुत सारे जंगली जानवरों के लिए आदर्श प्राकृतावास है । इन वनों का वर्गीकरण उत्तरी उष्ण आर्द्र पर्णपाती प्ररुपों के अन्तर्गत किया गया है जिनमें नाना प्रकार की और विविध परिस्थिति-संहतियाँ आती हैं। वनों का सामान्य सर्वेक्षण करने पर यहाँ कई महत्वपूर्ण पादप समुदायों के प्ररुपों का जैसे *शोरिया, मैलोटस* और *एडिना* समुदाय, *शोरिया, टर्मिनेलिया* और *ब्रिडेलिया* समुदाय, *सिजीगियम, फीबी* और *ड्रायपेटेस* समुदाय इत्यादि का पता लगा है । रुपाकृति और पादपमात्रिकी गठन के आधार पर इन वनों को छह प्ररुपों में बांटा जा सकता है अर्थात् *1*- शाल वन, *2*- मिश्र वन, *3*- नदीय वन, *4*- शुद्र वन, *5*- घास भूमि और *6*- उपोष्ण चीड़ वन । उपवन के अधिकांश भाग के शाल वनों में अधिरोही वृक्ष जाति *शोरिया रोवस्टा* गार्टन वत्स (शाल) की अमिश्र मेखलाएँ भी पाई जाती हैं । वनस्पतियों तथा पादप-पशु क्रिया-प्रतिक्रिया पर प्रभाव डालने वाले कारकों को इस अभिपत्र में बताया गया है । उपवन की विविध उष्ण परिस्थिति-संहतियों में कुछ विलक्षण विशिष्टताएँ मिलती हैं जिनकी समग्र परिस्थिति विकास के लिए वैज्ञानिक महत्व और व्यावहारिक सार्थकता दोनों हैं । घटते जा रहे पादप संसाधनों का विवेचन करते हुए उनके संभावित कारणों और विलुप्ति खतरे में आ पड़ी जातियों का संरक्षण करने के प्रभावकारी उपायों को भी इस अभिपत्र में बताया गया है ।

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A BENEFICIAL ASPECT OF NILGAI (*BOSELAPHUS TRAGOCAMELUS*) IN SCIENTIFICALLY UTILISED RAVINES - AN OBSERVATION

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Introduction

Nilgai (*Boselaphus tragocamelus* Pallas) is the most widely condemned antelope, often as a vermin, for the destruction it causes to agricultural, olericultural and pomological crops (Chauhan and Singh, 1990; Bohra *et al.*, 1992). Spread all over the length and breadth of plains and plateaus of tropical India from foot of Himalayas to Malabar and Gujarat to Assam (Sastri, 1956; Rana,1990), the Nilgai has remained undiminished even in Lion and Panther dominated Gir Wildlife Sanctuary (Java, 1991). True to the phenomenon of "survival of fittest" the prolific breeding Nilgai has sent clear signals that it is going to permanently stay on Indian soil and scene. Panicked farmers have switched on even to open-wire-electric-fencing, shooting, poisoning, etc. to eradicate Nilgai. Rodgers (1988) regrets that despite its spectacular height (2.2 m), heft (235 kg) and high density (25 km^{-2}) the endemic failed to lure animal scientists in its native land India and that the key studies on it have been undertaken elsewhere i.e. U.S.A. Non-existent in dense forests as well as wide- open treeless plains, the Nilgai's favourite haunts are tree-dotted agricultural lands i.e. farm-forests, agroforests, etc. and thus warrant a coordination of forestry, agricultural and animal scientists for its in-depth studies to develop a "live and let-live" technology to end the "farmer-Nilgai-tussle". This paper, in part fulfilment of "let-live" requirements, presents a beneficial aspect of Nilgai in scientifically utilised ravines studied during 1991 and 1992 at Research Farm, Chhalesar of Central Soil and Water Conservation Research and Training Institute, Research Centre, Agra.

Materials and Methods

Research Farm, Chhalesar (27^0 10' N, 78^0 02' E, 169 m a.s.l.) is located in ravines. Soil is alluvial sandy loam, annual precipitation 750 mm and natural vegetation Northern Tropical Ravine Thorn Forests. The compact Research Farm (81.6 ha) is under a variety of vegetative land uses viz. pastures, silvipastures and forests (65%), dry and irrigated farming, agroforestry and farm forestry (25%), pomology and olericulture (5%) and farm-stead, tubewells, etc. (5%). The adjoining surroundings are forests on north, grazing-lands on east, cultivated lands on west and perennial Yamuna river on the south. Thus adequate food, water and shelter, in and around, make the hunting-prohibited Research Farm, Chhalesar a safe haven for Nilgai.

Methods of on-the-spot complete census were adopted. Population, composition and mobility were determined through extensive reconnaissance survey followed by thorough counts during peak-activity period between 1500 and 2000 hours simultaneously along all the four boundary zones and inside of the farm. Day and night watching was done to determine habitat and dropping-site preferences of sedentary animals. Dropping-wise extraction and identification of seed-species was done to ascertain the number and range of seeds. The sinking-time of droppings in relation with abundance and seed-species was purely an accidental innovation during the process of extraction of seeds by dissolving of droppings in water for washing out seeds. It was revealed that the droppings having over 5 seeds of *Acacia nilotica* in each sank instantaneously, within 2 minutes, those with 2 to 5 seeds required upto 40 minutes. While those containing one or zero seed did not sink even after hours. Estimation of seed material for afforestation was done from a massive collection of summer droppings from all over the farm. Nitrogen contents in soil and droppings were determined by known laboratory methods.

Results and Discussion

Findings on a few facets of population, habitat, droppings, seed and nitrogen contents, etc. are presented and discussed for their beneficial aspects.

Population : Nilgai activities of local migration, first for watering and then for nocturnal foraging, are almost a 12-hour routine between 1600 and 0400 hours. Table 1 presents population, herd composition and local migration of Nilgai in the farm.

Average herd-size of six animals, one male, three females, and two calves. The number in the farm is higher in summer than that in winter obviously for availability of ameliorated shelter facilities. Usually about 100 animals subsist on farm resources of food, water and shelter round the year.

Table 1

Population, hard-composition and local migration of Nilgai in Research Farm, Chhalesar (81.6 ha)

Characters	Population (number)			Overall
	March '91	October '91	March '92	%
Herd-Composition:				
Male	67	23	47	19
Female	196	89	104	55
Calves	87	38	61	26
Total	350	150	212	100
Local-migration:				
Incoming	55	59	135	35
Outgoing	169	54	69	41
Sedentary	126	37	8	24
Total	350	150	212	100

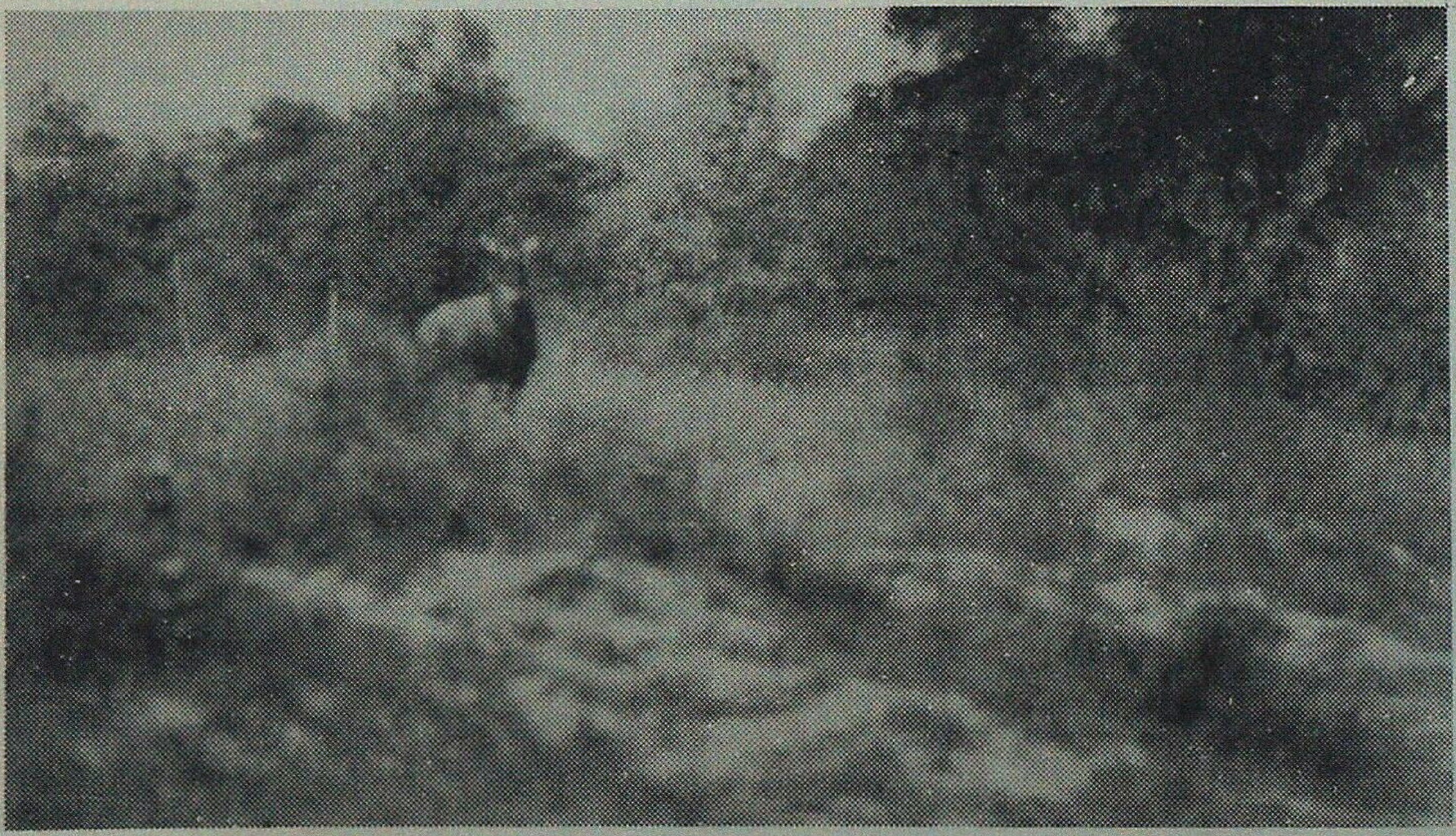
Habitat : The farm has three distinct habitats viz. open agricultural fields, farm-forests and forests. Nilgai preferred different habitats at different timings. Human presence was found to be inversely related with Nilgai presence in the habitats. The habit of nocturnal foraging of Nilgai is attributable to the absence of human component from the cropping lands during night time. Table 2 presents habitat preference of sedentary Nilgai.

Table 2

Habitat preference of sedentary Nilgai in Research Farm, Chhalesar (March, 1991).

Period	Habitat type	Number of Nilgai			Total	Per cent
		Male	Female	Calves		
Day time (Dawn to dusk) for shelter and resting.	Open agri-fields	-	-	-	-	-
	Farm forests	2	6	3	11	10
	Forests	22	62	31	115	90
	Total	24	68	34	126	100
Night time (dusk to dawn) for foraging.	Open agrifields	24	68	34	126	100
	Farm forests	-	-	-	-	-
	Forests	-	-	-	-	-
	Total	24	68	34	126	100

Fig. 1



An agile male Nilgai in farm forest in Research Farm Challesar.

To get the desired forage from a cropped-land guarded by man during night time the Nilgai surpasses human wits. It keeps in hiding, in pin-drop silence for hours together, till the guard is asleep and then noiselessly moves-in to do away with the desired forage. During day-time-resting in forests also the Nilgai remains equally agile to every likely danger from man (Fig. 1).

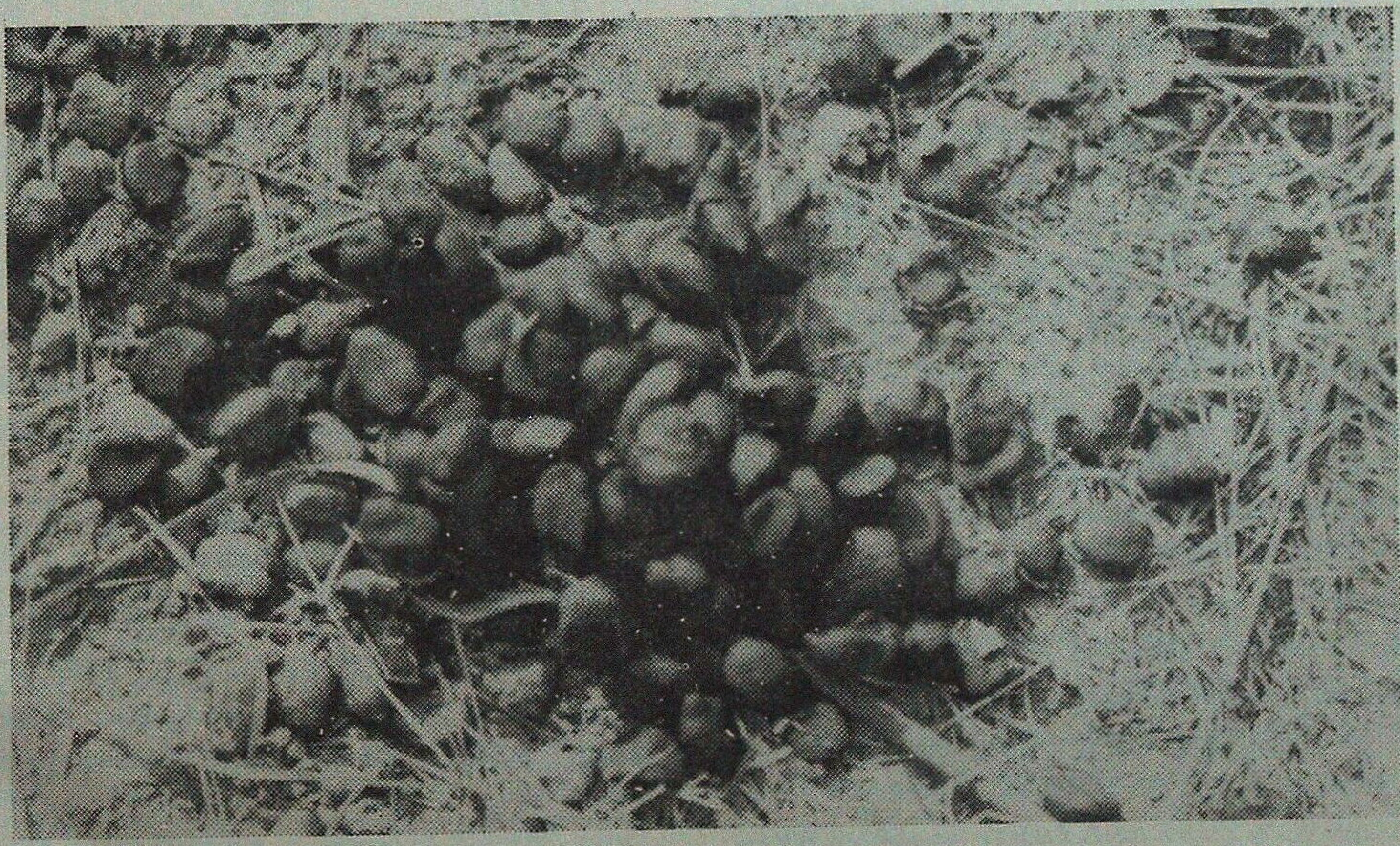
Droppings and seeds : The beneficial part of Nilgai droppings makes the theme of this paper. The droppings are a good source of *Acacia nilotica* and *Prosopis juliflora* seeds. Sites and sizes of droppings-hills, seed and nitrogen contents in droppings and their potential for afforestation are presented and discussed. Table 3 presents the number of droppings-hills of different sizes and at different sites in Research Farm, Chhalesar.

Table 3

Number of Nilgai droppings-hills of different sizes and at different sites (April, 1991).

Excretion time	Site	Number of droppings-hills in hill-size (kg)									Total
		1	2	3	4	5	6	7	8	10	
Night	Farm roads	2	2	1	4	6	-	2	1	3	21
	Fallow-agri-fields	-	-	3	1	1	-	1	-	-	6
Day	Ravine hump	-	1	2	2	2	-	1	-	3	11
	Open forest	-	2	2	1	2	1	1	-	-	9
Total		2	5	8	8	11	1	5	1	6	47

Fig. 2



Nilgai droppings

Selection of open sites for excretion is indicative of Nilgai's self defence strategy and agility.

Excepting the summer season (March-June) the droppings-hills are regularly subjected to termite and insect attacks during winter or to profuse germination of their seeds during rains ultimately becoming a part of soil. A Nilgai excretes about 1.5 kg droppings a day. Fresh dropping contain 39 and 55 per cent solid material on oven dry and air dry basis respectively. The droppings are hygroscopic in nature and the oven dry ones regain as much as 11% moisture when the air humidity is above 84%. The droppings size varies between 1.5 and 3.0 cm in length and 1.0 and 1.0 cm in width (Fig. 2).

Tree-seeds in droppings : Nilgai is a highly adaptable omnivorous browser. In absence of agri-olericultural delicacies during extremely hot months of May and June it switches on to shrub and tree leaf age and fruits. *Acacia nilotica* and *Prosopis juliflora* pods are summer delicacy for Nilgai. Table 4 presents tree seed contents in droppings.

Table 4

Number of tree-seeds in droppings (1991).

Tree species	Number of seeds in 100 droppings		
	May	June	July*
Acacia nilotica	211	52	150
Prosopis juliflora	102	891	261
Total	313	943	411

Note : * Monsoon commenced late hence pods were available in July also.

It is unbelievable but true that Nilgai is so keen for *Acacia nilotica* pods to the extent that it clean-sweeps the ground of every pod as soon as it falls. Tree-seeds in droppings in winter and rainy seasons were practically absent.

Seed range in droppings : The summer droppings of Nilgai are packed with tree-seeds. Tree-seed ranges in June and July droppings are presented in Table 5.

Table 5

Tree-seed ranges in Nilgai droppings (1991).

Seed range (Number/dropping)	Percentage of droppings	
	June	July
Zero	-	7
1-5	32	64
6-10	45	28
11-15	22	1
16-18	1	-
Total	100	100

Droppings contained seed of both *Acacia nilotica* and *Prosopis juliflora* but in above ranges majority was of *P. juliflora* seeds. In summer about 10 seeds/dropping are expected.

Sinking time versus seed abundance in droppings : Seeds of both *A. nilotica* and *P. juliflora* are heavier than water. About 1.5 cc in volume a dropping readily sinks in water if its seed contents weigh around one gram. This was amply revealed during the process of extraction of seeds by dissolving the droppings in water. Table 6 presents sinking time in relation with seed abundance of different tree-species in droppings.

Table 6

Sinking time versus tree seed-abundance in droppings

Sinking time (minutes)	Seed contents in each dropping		Weight (gm)
	A. nilotica (no.)	*P. juliflora* (no.)	
Upto 2	Above 5	Above 24	Above 0.7
3-20	4-5	20-24	0.5-0.7
21-40	2-3	9-19	0.3-0.5
Above 40	Below 2	Below 9	Below 0.3

Note : Weight of seeds: *A. nilotica* =0.13 gm seed^{-1} and *P. juliflora*=0.0286 gm seed^{-1}.

In the droppings the abundance of *A. nilotic - a* seeds is higher in May while that of *P. juliflora* seeds in June and July. In the month of July 1991, 74% droppings contained seeds of *A. nilotica* and 81% of *P. juliflora* and 67% of both of them . The sinking time is thus a function of the combined weight of seeds in the droppings.

Droppings and Soil fertility : Droppings contain 1.568 percent nitrogen. They are a rich source of nitrogen and organic carbon. Table 7 presents the effects of Nilgai droppings on nitrogen and organic carbon contents in soil profile.

Table 7

Nitrogen and organic carbon contents in soil profile under droppings-hills and open land (May 1991).

Depth (cm)	Under droppings hills	Open land
Available nitrogen (kg ha^{-1})		
0-15	227.4	198.6
15-30	193.4	159.4
30-60	125.4	128.5
Organic carbon (%)		
0-15	0.237	0.218
15-30	0.182	0.162
30-60	0.158	0.156

Addition to the tune of 28.8 to 34.0 kg nitrogen per hectare and 0.02 per cent organic carbon to 0-30 cm depth of soil by Nilgai droppings amply indicates that this organic resource can be profitably tapped for the benefit of agricultural, olericultural and pomological crops and pastures.

Seed material for afforestation : Procurement of *A. nilotica* and *P. juliflora* seed material for afforestation involves pod collection, seed extraction, drying, cleaning, grading and presowing treatments. Nilgai does all these exercises for man, and that too free of cost, and, as a step forward, leaves ample quantity of ready-for-use pelleted seeds in the droppings-hills. Seed material potentials in 100 kg droppings gathered from 4 months old (March-June) droppings-hills are presented in Table 8.

Table 8

Seed contents in summer droppings and their sufficiency for afforestation.

Tree species	Seed contents in 100 kg droppings		Seed Sufficiency for afforestation (ha)
	Weight (kg)	Count (no.)	
Acacia nilotica	3.0	20,000	1.0
Prosopis juliflora	5.0	1,40,000	5.0
Total	8.0	1,60,000	6.0

Note : In 100 kg weight there are 30,000 to 40,000 droppings.

Trials indicated that *Acacia nilotica* seeds obtained from droppings had 64% germination within 16 days as compared to 41 % in 25 days of those collected directly. In the case of *Prosopis juliflora* there was no change in germination per cent but the germination period advanced from 26 days to 21 days. The species and quantity of seeds in droppings can be controlled by synchronizing pod maturity and excretion and collection timings. Dibbling of such controlled droppings, would ensure afforestation with specific species. The naturally, timely and effortlessly available Nilgai droppings are ideally and evenly sized nutrified organic capsules packed with appropriate number of treated seeds ready to vigorously and prolifically germinate with first showers. Easy to handle, simple to use and quick to work-with the cheaply available Nilgai droppings are a boon to boom afforestation.

Acknowledgements

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SUMMARY

The Nilgai (*Boselaphus tragocamelus*) is condemned as a vermin. There is a need to develop a "live and let-live" technology to end the "Farmer-Nilgai-tussle'. Studies in Research Farm, Chhalesar indicate that Nilgai is "not-all-worthless". Situated in ravines along river Yamuna the Research Farm (81.6 ha) with all essentials for life viz. 65% forests and 35% agriculture, horticulture, water-holes,etc. makes a safe haven for Nilgai. There exist about 100 heads using forests for shelter and resting in day time, agricultural fields for foraging in night time and the river for watering. Nilgai's summer droppings containing 5-10 seeds each are a good source of *Acacia nilotica* and *Prosopis juliflora* seeds. The droppings also contain 1.568% nitrogen enriching the soil profile upto 30 cm depth by above 30 kg N ha^{-1} and 0.02% organic carbon. About 100 kg summer droppings, numbering as much as 40,000, contain sufficient seeds to afforest 6 ha area. For raising forest of *A. nilotica* droppings of May and for that of *P. juliflora* the same of June should be used. The naturally, timely and effortlessly available Nilgai droppings are ideally and evenly sized nitrified organic capsules with appropriate number of treated seeds ready to vigourously and prolifically germinate with first showers. Easy to handle, simple to use and quick to work-with the cheaply available Nilgai droppings are a boon to boom afforestation.

वैज्ञानिक ढंग से उपयोजित राहढ़ों में नीलगाय (*बोसिलेफ्स ट्रैगोकैलेमस*) का लाभकारी पक्ष - एक प्रेक्षण

एम० सी० प्रजापति व सुरेन्द्र सिंह

सारांश

नीलगाय (*बोसिलेफ्स ट्रैगोकैलेमस*) की पीड़क जन्तु कह कर निन्दा की जाती है । किसान और नीलगाय का झगड़ा खत्म करने के लिए 'जियो और जीने दो' प्रौद्योगिकी विकसित करने की आवश्यकता है । अनुसंधान महाक्षेत्र, छलेसर में किए अध्ययन संकेत देते हैं कि नीलगाय 'पूर्णतया बेकार ' ही नही है । यमुना नदी और अनुसंधान महाक्षेत्र के बीच फैले (81.6 हेक्टेयर) रोहड़ जिसमें जीवन की सभी अनिवार्य आवश्यकताँए अर्थात 65% वन और 35% खेती, बागवानी, जल क्षेत्र आदि उपलब्ध हैं, नीलगायों के सुरक्षित पत्तन जैसा है । इसमें लगभग 100 नीलगाय हैं जो आश्रय और दिन में विश्राम के लिए वनों, रात को चरने के लिए खेतों और पानी पीने के लिए नदी उपयोग करती हैं । नीलगाय की गर्मियों की मींगनी, जिसमें प्रत्येक में 5-10 बीज होते हैं *अकेसिया नीलोटिका* और *प्रोसोपिस जूलिफलोरा* के बीजों का अच्छा स्रोत है । नीलगाय की मींगनी में 1.568% नाइट्रोजन होता है जो 30 से० मी० गहराई तक प्रति हेक्टेयर लगभग 30 कि० ग्रा० से ऊपर नाइट्रोजन और 0.02% जैव कार्बन डालकर मृदा को सम्पन्न बनाता है । गर्मियों की लगभग 100 कि० ग्रा ० मींगनी में, इनकी संख्या 40,000 जितनी अधिक होती है ।

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A PRELIMINARY STUDY ON THE GRASSLANDS OF PERIYAR TIGER RESERVE, KERALA

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Periyar Tiger Reserve, Thekkady (Kerala)

Introduction

Grasslands have a very important role in wildlife management as they provide excellent forage for herbivores. Periyar Tiger Reserve has about 54 km^2 area under grasslands. They can be divided into two major categories, (1) Tropical Montane Grasslands and (2) South Indian Subtropical Hill Savannahs. Animals like the Sambar, the Gaur, the Nilgiri Tahr, the Elephant and the Wild Boar utilize the grasslands as their major food resource. Though grasslands seem to have poor species diversity, they maintain a good species composition. Apart from the grasses, a rich herbaceous undergrowth occurs in the grasslands. The major objectives of this study are (1) to describe the species diversity of grasslands and distribution of different species of grasses, (2) to assess the forage value of the grasslands and the extent of interaction for larger mammals, and (3) to estimate the effect of forest fire on the regeneration capacity of grasses and other herbs seen in grasslands of Periyar Tiger Reserve.

Study Area

The Periyar Tiger Reserve is situated on the Southern-Western Ghats in the Idukki District of Kerala and lies between 9°17' and 9°37' N latitude and 76°56' and 77° 25' E longitude. Topographically the reserve is in between 150 m and 2116 m from m.s.l. The terrain is highly undulating. A dam was constructed across the river Periyar which has resulted in the formation of a lake having an area of 26 km^2. The reserve has an area of 777 km^2, of which 54 km^2 is under grasslands and the rest under other forest types like Southern Tropical Wet Evergreen Forests, Southern Tropical Semi-evergreen forests and South Indian Moist Deciduous forests etc. The area has moderate climate throughout the year except for summer month. The rainfall is generally heavy since the area is benefitted by south-west and north-east monsoons.

Methodology

The study on grasslands was carried out from January to December 1992 while carrying out wildlife monitoring through fixed transects. Grasses, trees, shrubs and herbs collected from the field were identified in the laborotary with the help of various 'floras'. Identifications were confirmed by comparing these collections with standard specimens kept in recognized herbaria. Plot study was also conducted in the field using quadrat method to find out the species diversity and the impacts of *Eucalyptus* plantations on grasslands. Studies were carried out in different types of grasslands for comparison. The impact of fires was studied by comparing the burnt grasslands with the unburnt areas in the month of November/December (early season), February (middle season), in April (late season). Observations were made in each of the burnt plots with an interval of two weeks, just after the first rain and then after two weeks.

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Results

Depending upon the distribution, grasslands of this Reserve could be divided into three categories. They are, Grasslands on the hill tops, along the savannahs and hill slopes and those along the lake shores and marshy places. Altogether 64 species of grasses were collected and identified from the reserve. Besides the grasses, 14 species of trees, 10 species of shrubs and around 46 species of herbs were also observed in the grasslands. Their distribution is given in the Table 1.

Among the various species of grasses, tabulated in Table 1, only one species, *Arundinella tuberculata*, was more or less uniformly distributed in the three categories of grasslands. Ten species had a lesser extent of distribution. They were *Cymbopogon coloratus, C. flexuosus, Digitaria sanguinalis, Dimeria ornithopoda, Eragrostis atrovirens, E. brevifolia, Ottochloa nodosa, Imperata cylindrica, Panicum atrosanguineum* and *Themeda triandra.* Thirty two species had restricted distribution. Species diversity is more in savannahs and less in hill tops. The most dominant species in savannahs is *Cymbopogon coloratus* and on hill top is *Eragrostis bifaria.* The dominant species of lake shore was *Panicum repens.*

Grasses seen in moist deciduous forest floor are also given in the Table 1. Fifteen species were collected from deciduous forests of which 3 species of *Cyrtococcum* were restricted to this biotope. *Oplismenus compositus, O. burmannii* and *Oryza granulata* (wild rice) were found in semi-evergreen forests also. But evergreen forests were seem to be devoid of any grasses. Around nine species of grasses were collected from *Eucalyptus* plantations. But they had a scanty occurrence.

Trees were seen only in savannahs and the dominant species was *Terminalia paniculata.* Of the 10 shrubs observed, two species viz, *Strobilanthus* sp. and *Phoenix humilis* were seen in hill tops only. Seventeen herbs were also restricted to hill tops. Six species of insectivorous plants were also collected from the study area. They were *Drosera indica, D. peltata, D. burmannii, Utricularia caerulea, U. striatula* and *U. rosea-purpurea.* Parasitic herbs attacking on roots of grasses such as *Striga lutea, S. orobanchoides, Christisonia tubulosa, C. bicolor* and *Aeginetia pedunculata* were also observed.

Orchids namely, *Plantanthera susannae, Habenaria longicalcarata, H. longicornu* were also collected from the grasslands. These orchids were seen in grasslands only. *Platanthera susannae* was considered as an endangered species (Vivakananthan, 1978). Few ferns were also found in grasses. They were *Pteridium* sp., *Selaginella lycopodioides, Hemionites cordata* and *Lycopodium cernuum.*

In the early season burning the following changes were noted :

(1) The shoots and culms of grasses were burnt only partially.
(2) The unburnt grass stumps were of 30 to 60 cm high.
(3) The rhizomes and other underground parts of grasses were found unaffected.
(4) Herbs were burnt.
(5) Leaves of shrubs were burnt.
(6) Trees were unaffected; green leaves were still seen.

During the middle season burning the following were observed :

(1) Stems and culms of grasses were burnt.
(2) The unburnt stumps of grasses were of less than 30 cm high.
(3) No herbs or sign of herbs were left unburnt.
(4) Shoots of shrubs were burnt.
(5) Leaves of trees were dried.

The late fire season had the following results.

(1) The entire grass upto floor level were burnt.
(2) No trace of herbs were left.
(3) Shoots of shrubs were burnt.
(4) Leaves of trees were dried; barks of some trees were burnt.

Two weeks after burning the underground rhizome of the grasses start producing new shoots. *Imperata cylindrica* was the first species to regenerate from rhizome. No regeneration of herbs or shrubs were seen. after four weeks of burning trees started to bear fresh leaves.

During the first rain the runaway water from the late burnt areas had black colour. The ashes were carried along with rain water. At this time the early burnt areas were more or less covered by fresh leave of grasses. But the germination of seeds of other herbs was yet to start two weeks after the first rain new seedlings of grasses and herbs were seen, the frequency of which varied in early burnt grasslands, late burnt grasslands and unburnt grasslands.

Discussion and Conclusions

Topography plays a major role in the distribution of grasses in Periyar Tiger Reserve. The majority of species present in these grasslands are of good forage value. Grasslands are the major source of food for the herbivores like the Gaur, the Sambar, the Barking Deer and the Nilgiri Tahr besides the Elephants and the Wild boar. Some grasses like *Panicum repens, P. maximum, Apluda aristata, Cymbopogon confertiflorus* etc. are taken by most of the larger herbivores. Even though some dominance of species of *Cymbopogon* was noticed in savannahs it provides micro-habitat for plants like *Platanthera susannae* and *Lilium wallichianum* and evergreen forests, grasslands supported more number of large mammals (Nair., *et al.* 1985). Grasslands are hence to be protected and preserved. The old concept that "Grasslands are sterile" is hence meaningless. Fire is an important factor in maintaining grasslands (Bor, 1960). Fire accelerates and facilitates germination of seeds of grasses and other herbs in grasslands.

The forest fire has some demerits also. They cause soil erosion and extreme entropy in energy budget in grasslands ecology. However, a more or less adaptable ecosystem is gradually developing in fire affected areas. A gradual but changing species composition may be the consequence of seasonal fires in grasslands. For a better understanding

Table 1

The distribution of grasses and herbs in various types of grasslands

Species	Hill top	Hill slopes and savannah	Lake shore	Dec. forest	*Eucalyptus* plantation
1	2	3	4	5	6
GRASSES Family : Gramineae					
Alloteropsis cimicina	-	x	-	-	-
Apluda aristata	-	x	-	-	-
Apocopis wightii	x	-	-	-	-
Arthraxon quartinianus	x	x	-	-	-
Arundinella mesophylla	x	x	x	-	x
Arundinella tuberculata	x	x	x	x	x
Axonopus compressus	-	x	x	-	-
Bothriochloa pertusa	-	x	-	-	-
Briza minor	-	-	x	-	-
Centotheca lappacea	-	-	-	x	-
Chrysopogon fulvus	x	x	-	-	-
Chloris barbatus	-	-	x	-	-
Chrysopogon sp.	-	-	x	-	-
Coelachne simpliciuscula	x	x	-	-	-
Coix lachryma-jobi	-	x	-	-	-
Cymbopogon citratus	-	x	-	-	x
C. coloratus	x	x	-	-	x
C. confertiflorus	x	x	-	-	-
C. flexuosus	x	x	-	-	x
Cynodon dactylon	-	-	x	-	-
Cyrtococcum oxyphyllum	-	-	-	x	-
Cyrtococcum muricatum	-	-	-	x	-
C. patens	-	-	-	x	-
C. accrescence	-	-	x	-	-
Dactyloctenium aegyptium	-	-	x	-	-
Digitaria sanguinalis	-	x	x	x	-
Dimeria ornithopoda	-	x	x	x	-
Eleusine indica	-	-	x	-	-
Eragrostis atrovirens	-	x	x	x	-
E. bifaria	x	-	-	-	-
E. brevifolia	-	x	x	x	-
E. tef.	-	-	x	-	-
E. willdenoviana	-	-	x	-	-

(Contd...)

1	2	3	4	5	6
E. unioloides	-	-	x	-	-
Garnotia arundinacea	x	x	-	-	-
Heteropogon contortus	x	-	x	-	x
Imperata cylindrica	x	-	x	-	x
Indochloa oligantha	-	-	-	x	-
Ischaemum pilosum	x	x	-	-	-
Jansenella griffithiana	x	x	-	-	-
Leersia hexandra	-	-	x	-	-
Manisuris granularis	-	x	-	x	-
Oplismenus compositus	-	-	-	x	-
O. burmannii	-	-	-	x	x
Oryza granulata	-	-	-	x	-
Ottochloa nodosa	-	x	-	x	-
Panicum atrosanguineum	x	x	x	-	-
P. brevifolium	-	x	x	-	-
P. interruptum	-	-	x	-	-
P. javanicum	-	-	x	-	-
P. montanum	-	x	-	-	-
P. maximum	-	x	-	-	-
P. repens	-	-	x	-	-
Pennisetum hohenackeri	-	x	-	-	x
P. polystachyon	-	x	-	-	-
Perotis indica	-	-	x	-	-
Pogonatherum crinitum	-	-	x	-	-
Rottboellia exaltata	-	x	x	-	-
Saccharum spontaneum	-	-	x	-	-
Setaria palmifolia	-	-	-	x	-
S. intermedia	-	-	x	-	-
Setaria sp.	-	-	-	x	-
Sporobolus indicus	-	x	-	-	-
Themeda triandra	x	x	x	-	-
HERBS					
Family : Violaceae					
Viola pilosa	-	x	x	-	-
Family : Polygalacaeae					
Polygala bolbothrix	-	-	x	-	-
P. erioptera	-	x	-	-	-
Family : Hypericaceae					
Hypericum japonicum	-	-	x	-	-

(Contd...)

1	2	3	4	5	6
Family : Geraniaceae					
Impatiens hensloviana	-	-	x	-	-
Family : Fabaceae					
Crotalaria calycina	x	-	-	-	-
C. humifusa	x	-	-	-	-
C. triquetra	x	x	-	-	-
C. umbellata	x	-	-	-	-
Desmodium alysicarpoides	x	x	-	-	-
D. ferrugineum	x	-	-	-	-
D. pulchellum	-	x	-	-	-
D. triflorum	-	x	-	-	-
Goniogyna hirta	x	x	-	-	-
Indigofera prostrata	x	-	x	-	-
Rhynchosia cana	x	x	x	-	-
Family : Melastomaceae					
Osbeckia courtallensis	x	-	-	-	-
O. leschenaultiana	-	x	-	-	-
O. truncata	x	x	-	-	-
Family : Rubiaceae					
Borreria stricta	x	-	-	-	-
Knoxia spp.	-	x	-	-	-
Family : Compositae					
Adenoon indicum	x	-	-	-	-
Blumea laciniata	-	x	-	-	-
B. spectabilis	-	x	-	-	-
Grangea maderaspatana	-	-	x	-	-
Lactuca runcinata	-	x	x	-	-
Vernonia setigera	-	x	-	-	-
Family : Companulaceae					
Wahlenbergia gracilis	-	x	-	-	-
Family : Gentianaceae					
Canscora wallichii	x	x	-	-	-
Erythraea roxburghii	x	-	-	-	-
Swertia corymbosa	x	-	-	-	-

Contd...

1	2	3	4	5	6
Family : Scrophulariaceae					
Ilysanthes veronicaefolia	-	-	x	-	-
Limnophila gratissima	-	-	x	-	-
Family : Gesneriaceae					
Didymocarpus lanuginosa	-	x	-	-	-
Family : Acanthaceae					
Andrographis rothii	x	-	-	-	-
Hygrophila angustifolia	-	-	x	-	-
Justicia procumbens	-	x	x	-	-
Micranthus oppositifolius	-	-	-	x	-
Family : Labiatae					
Leucas aspera	x	-	-	-	-
Leucas prostrata	x	x	-	-	-
Family : Orchidaceae					
Platanthera susannae	x	-	-	-	-
Family : Liliaceae					
Lilium wallichianum	x	-	-	-	-
Family : Commelinaceae					
Cyanotis arachnoidea	x	-	-	-	-
C. papilionacea	x	-	-	-	-
Family : Eriocaulaceae					
Eriocaulon malabaricum	-	-	x	-	-
Family : Cyperaceae					
Mariscus dubius	-	-	x	-	-
INSECTIVOROUS PLANTS					
Family : Droseraceae					
Drosera burmannii	x	x	-	-	-
D. indica	x	-	-	-	-
D. peltata	x	-	-	-	-
Family : Lentibulariaceae					
Utricularia caerulea	x	x	x	-	-
U. roseapurpurea	x	-	-	-	-
U. striatula	x	-	-	-	-

Contd...

1	2	3	4	5	6
PARASITIC PLANTS					
Family : Scrophulariaceae					
Striga lutea	x	x	-	-	-
S. orobanchoides	x	x	-	-	-
Family : Orobanchaceae					
Aeginetia pedunculata	x	x	-	-	-
Christisonia bicolor	x	x	-	-	-
C. tubulosa	x	-	-	-	-
SHRUBS					
Family : Hypericaceae					
Hypericum hookerianum	x	-	-	-	-
Family : Sterculiaceae					
Helicteres isora	-	x	-	x	-
Family : Rhamnaceae					
Zizyphus rugosa	-	x	-	x	-
Family : Fabaceae					
Crotalaria striata	-	x	-	x	-
Family : Compositae					
Eupatorium adenophorum	-	x	-	x	-
Family : Acanthaceae					
Strobilanthes barbatus	-	-	-	x	-
Strobilanthes spp.	-	-	-	x	-
Strobilanthes spp.	-	-	-	x	-
Family : Verbenaceae					
Lantana camara	-	x	-	x	-
Family : Arecaceae					
Phoenix humilis	x	-	-	-	-
TREES					
Family : Sterculiaceae					
Sterculia villosa	-	x	-	x	-

Contd...

1	2	3	4	5	6
Family : Tiliaceae					
Grewia tiliaefolia	-	x	-	x	-
Family : Fabaceae					
Dalbergia latifolia	-	x	-	x	-
D. paniculata	-	x	-	x	-
Pterocarpus marsupium	-	x	-	x	-
Family : Combretaceae					
Anogeissus latifolia	-	x	-	x	-
Terminalia chebula	-	x	-	x	-
T. paniculata	-	x	-	x	-
T. tomentosa	-	x	-	x	-
Family : Lecythidaceae					
Careya arborea	-	-	-	x	-
Family : Rubiaceae					
Wendlandia lawii	-	x	-	x	-
Family : Verbenaceae					
Tectona grandis	-	x	-	x	-
Family : Euphorbiaceae					
Emblica officinalis	-	x	-	x	-
Glochidion ellipticum	-	x	-	x	-

Table 2

Species diversity in various grassland systems

Plant form	Hill tops	Savannahs	Lake shore	Dec. forest	*Eucalyptus* plantation
Grasses	17	32	31	17	9
Herbs	17	13	14	8	-
Shrubs	2	8	-	not observed	not observed
Total	36	53	45		

about the impact of seasonal fires in grasslands a long term study is required :

Controlled burning : This study showed that an early fire in grasslands caused lesser harm. Early burning hence could be a solution to avoid the harmful late fire, for keeping species diversity and for providing an year round forage supply to herbivores.

The afforestation programme on grasslands by planting *Eucalyptus* were detrimental to grasslands. Very few number of grasses and herbs could survive in *Eucalyptus* plantations.

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SUMMARY

Periyar Tiger Reserve has a grassland area of about 54 km^2. It supports rich herbivorous animal populations. The grasslands of this Reserve are divided into Tropical Montane grasslands and South Indian Subtropical Hill Savannahs.

Besides their forage value, the grasslands are potential for maintaining micro-climates for many endangered plants and animals. Forest fire is one of the major ecological factors in grasslands. Planting of *Eucalyptus* and other exotic plants destabilize the ecology of grasslands which are ideal habitats for endangered species of fauna like Nilgiri Tahr, Nilgiri Pipit etc.

पेरियार बाघ संरक्षित क्षेत्र, केरल के घास प्रदेश का प्रारम्भिक अध्ययन

के० के० श्रीवास्तव, वी० जे० जकरियास, ए० के० भारद्वाज, जोमी आगस्तीन व शर्ली जाजेफ

सारांश

पेरियार बाघ संरक्षित क्षेत्र में लगभग 54 वर्ग कि० मी० घासभूमि क्षेत्र है। इस पर सम्पन्न शाक भक्षी पशु संख्या पलती हे। संरक्षित क्षेत्र की घासभूमि उष्णदेशीय पर्वतीय घास क्षेत्र और दक्षिण भारतीय उपोष्ण पहाडी घास क्षेत्र इन दो भागों में बटी हुई है।

अपने चारा मूल्य के अतिरिक्त इस घासभूमि में विलोप खतरे में आए बहुत से पादपों और पशुओं के लिए उपयुक्त अणुजलवायु बनाकर रखने की क्षमता भी हैं। घासभूमि का एक बड़ा पारिस्थिकीय कारक इनमें आग लगते रहना है। *युकेलिप्टस* और परदेशीय पादप लगाए जाने से इस घासभूमि परिस्थितियां उखड़ रही है जो नीलगिरि बकरी, नीलगिरि तुलिका आदि जैसी विलुप्ति खतरे में आई प्राणि जातियों का आदर्श प्राकृतावास हैं ।

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AN APPROACH TO THE MANAGEMENT OF GRASSLANDS IN GREAT INDIAN BUSTARD AREAS

A.K. NIGAM*, D.K. TYAGI** AND S.M. GUJAR***

Introduction

The Great Indian Bustard *Ardeotis nigriceps* (Vigors) is an endemic species to the Indian Sub-continent. A century ago the bustard ranged from the present Pakistan East to West Bengal and Orissa and Southward through the peninsular to Southern Madras (Ali and Ripley, 1969). Excessive shooting and destruction and fragmentation of its habitat over the period of time have greatly reduced the number of the bustard. Today, six Indian States are reported to have the small bustard population. The estimated country's bustard population at present is about 1900 plus. Rajasthan has about 1,500 bustards, Andhra Pradesh about 150, Maharashtra and Madhya Pradesh about 100 each and Gujarat and Karnataka about 30 each (Rahmani, 1989).

The bustard is a bird of open landscape, mostly inhabiting grassy plains in arid areas, interspersed with scrub and low bushes and farmlands. The Sholapur, Ahmednagar and Aurangabad are as of Maharashtra have such tracts and provide required habitat to this bird. There are records showing shooting of about 961 birds between 1809 to 1829 in the neighbourhood of Ahmednagar only (Oriental Sporting Magazine, 1881). Tyabji (1952) states that between 1923-1926 he saw flocks of 200 to 300 bustard around Manmad. However the systematic efforts made since 1977 to survey the status of bustard in Maharashtra showed that the present bustard population in Maharashtra varies from 75 to 100 birds (Rego, 1980 and Rahmani, 1989; unpublished census estimate of Great Indian Bustard Sanctuary managers).

Great Indian Bustard area and type of Grassland

The Great Indian Bustard areas i.e. mainly Sholapur and Ahmednagar though do not have grassland in true sense as the climate conditions are not at all conducive to the occurrence of grasslands, however as the areas climatic condition even not conducive to the tree growth also the vegetation of scattered stunted growth and patches of grasses can be broadly typed as grasslands or the pasture. The grasslands of Sholapur and Ahmednagar can be broadly categorised under the *Sehima-Dichanthium* type of Whyte, 1957 classification of grassland types of India. The details of total district area of Sholapur and Ahmednagar, the total forest area and Great Indian Bustard Sanctuary area in each district taluka-wise is as under :

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(a) Total Geographical area of Ahmednagar Distt. = 17048.00 km^2
Forest area of Ahmednagar Distt. = 1430.04 km^2
Area of Great Indian Bustard Sanctuary = 3379.76 km^2
Total Forest area in GIB Sanctuary = 316. 47 km^2

Taluka	GIB Sanctuary Area (ha)	Forest Area (ha)
Newase	283338	897
Shrigonda	160481	14047
Karjat	149157	16703
	337976	31647

(b) Total Geographical area of Sholapur District = 15017 km^2
Forest area of District = 195.51 km^2.
Area of Great Indian Bustard Sanctuary = 5116.68 km^2
Total Forest area in GIB Sanctuary = 6664.40 km^2

Taluka	GIB Sanctuary Area (ha)	Forest Area (ha)
Mohol	131689	1429.18
Karmala	159572	3223.49
Madha	152610	1147.47
North Sholapur	67797	864.26
	511668	6664.40

Total area of Great Indian Bustard Sanctuary is 8496.44 km^2 in the both the districts.

Vegetation of Great Indian Bustard Area

The common tree species, shrub species and dominant grass species of Great Indian Bustard areas are :

1. Trees : *Azadirachta indica, Albizia lebbek, Zizyphus mauritiana, Dalbergia sissoo, Hardwickia binata, Acacia nilotica, Acacia catechu, Acacia leucophloea, Santalum album.*

2. Shrub : *Gymnosporia montana, Cassia congesta, Capparis aphylla, Cassia auriculata, Alangium lamarckii, Tephrosia purpurea.*

3. Grasses : *Heteropogon contortus, Chrysopogon fulvus, Sehima sulcatum, Sehima nervosum, Andropogon pumilis, Eragrostis tremula, Cymbopogon martiniti, Dichanthium annulatum, Ischaemum pilosum.*

The grasses such as *Cenchrus ciliaris, Chloris gayana* and legumes such as *Stylo solichos* etc. have also been introduced in some pockets.

Grassland Management Objectives

The objectives behind managing the grassland/pasture of Great Indian Bustard area is to provide ideal habitat for the conservation of the wildlife and preservation of the biodiversity of the area. The principal species, of course is the Great Indian Bustard, a rare bird but in addition to this the Black-buck, Chinkara, Wolf etc. are also form part of wild fauna of Great Indian Bustard area. The other vital objective of managing the grassland of Great Indian Bustard area is to meet the peoples demand specially with regard to fodder for their cattle to avoid any incoming people-wildlife conflict and to maintain the ecological balance of the area.

The habitat requirements of the principal faunal special are almost similar. All major faunal species prefer the grassland. scrubland, grazing land, stony wasteland and crop fields. The Great Indian Bustard specially prefer wide open short grass plains and open scrubland with scattered trees (Rahmani, 1989). It has rarely seen in the damp or water logged areas and sugarcane/wheat crop fields.

Existing Grassland Management Practices

The existing management practices of grassland management in India viz-a-viz grass cutting, controlled grazing and burning are targeted towards removal of tall unpalatable grasses, prevention of shrub/tree encroachments, stimulation of fresh growth i.e. regeneration and fire protection. However, the grass cutting involves higher expenditure, the controlled grazing is always difficult to practise and prohibit natural regeneration owing to the compaction of soil and lastly the controlled burning involves a loss of nitrogen and sulphur, minerals etc. due to surface wash, add to environmental pollution and tend to made the vegetation more xerophytic consequently thick bark, more silica content and calcium exalate crystal thus making the grasses unpalatable and less nutritious make the soil drier and drier though it is easy to practise (Rodgers, 1986).

The grassland in India is a "Pre-climax" stage (Bor, 1942; Champion and Seth, 1968) except in certain cases where it is "edaphic climax" hence the input of management practices are essential to maintain the grassland as such and to keep the grasses palatable. The limited grazing and the burning management practices to maintain grasslands are not ideally suited considering their negative impact.

An approach to Grassland Management in Great Indian Bustard area

The grass cutting seems to be an ideal solution to the Great Indian Bustard area as it has almost no negative impact over the grassland and is labour intensive also. The only thing which is required is to distribute the cut grass immediately to the local villagers or preserve them either dry or in silage for the distribution in pinch period.

The grass cutting in Great Indian Bustard areas should be started after the breeding season (July-Nov.) is over. The grass cutting should be done on rotational basis as to provide the habitat of both short and tall grasses. The Great Indian Bustard requires short grasses for its nesting purpose and tall grasses for rearing of the chicks. The other management consideration which should be taken into consideration before going for grass cutting is the drop in biomass production and crude protein yield and effect on grasses regeneration if the grass cutting is delayed. The ideal period to encourage grasses regeneration and biomass production seems to be 50 to 85 days after the onset of rain. It is therefore felt that in those areas where Great Indian Bustard concentration is more the grass cutting should be applied after November and in rest of the Great Indian Bustard areas the grass cutting should be preferred after three months of onset of the rains (Singh, 1988).

Silvi-Pasture vs. Grassland

The protection given under various Forestry Acts such as Wildlife (Protection) Act, 1972 amended in 1991, Forest Conservation Act, 1980 etc., the consistent efforts of Forest Deptt. to conserve wildlife and efforts made by Non-Govt. Organisations and eco-conscious people, the status of wildlife has been improved to an appreciable extent. To meet the growing demands of food for the first link of food chain i.e. the primary consumers or the herbivores, it is essential that the eco-system should be managed to produce the optimum biomass. The primary producers which fix the sunlight, the only source of energy for all ecosystems into the consumable energy are most vital components of an ecosystem. The grasses are the primary producer in the grassland ecosystem. The optimum production of biomass which is one of the management aspects depends upon the land utilization as per the capability and the type of primary producers. There are records which reveal that the silvi-pasture produces more biomass than the grasslands or the pasture. The estimated area of biomass production (t/ha/yr) from a managed pasture is about 3.5-5.5 and from a managed silvi-pasture it is about 7.0 to 15.0 (Pathak and Patil, 1988). The grasses productivity is also recorded to be high under the shade of trees than the open areas (Mann and Muthana, 1984). The management issue involved here is whether the pasture management should be undertaken or the silvi-pasture is a better option.

In the Great Indian Bustard area the principal target species is the Great Indian Bustard which requires the open short grass plains and open scrubland with scattered trees. It is suggested that in the area of Great Indian Bustard concentration the native fodder trees of shorter height such as *Acacia leucophloea* and shrub of food value (*Zizyphus mauritiana*) should be encouraged to grow. In other Great Indian Bustard area it would be better if the pasture managed as silvi-pasture. The nuritive value of some of the native fodder trees are given in Table 1.

Improvement of existing Grassland

The existing open grasslands with scattered trees can also be improved in the Great Indian Bustard areas by improving the existing stock of grasses by way of planting of superior acclimatized grass species. The common species of vegetation of grasslands of Great Indian Bustard area include *Aristida funiculata, Aristida redacta, Aristida stocksii, Heteropogon*

Table 1

Nutritive values of some of the native fodder trees.

Tree species	Crude Protein (%)	Crude Fibre(%)	Crude Fat (%)	Total Ash (%)
Acacia catechu	13-18	21-22	3-4	9-9.8
Acacia nilotica	13-15	15-20	4-5	1-4
Azadirachta indica	12-18	11-13	2-6	7-18
Dalbergia sissoo	16-24	22-31	2-4	8-13
Ficus bengalensis	7-11	13-29	2-5	9-16
Hardwickia binata	7-8	35-49	3-4	-
Prosopis cineraria	13-15	17-22	3-4	3-9
Zizyphus mauratiana	12-16	13-17	1-3	10-11
Acacia leucophloea	10-15	15-18	2-3	5-7

Source : *Fodder trees of India.* by R.V. Singh *contortus*, *Lophopogon contortus*, *Chrysopogon fulvus* etc. These species of grasses are not of good fodder value (Lisboa, 1896). In addition to the planting of superior species of grasses of good fodder value emphasis should also be given on soil and moisture conservation works as these works too improve the grass vegetation to the superior kind by way of natural succession. The rate of natural succession in refractory areas such as Great Indian Bustard area though slow but the inferior species such as *Aristidas* and *Heteropogon contortus*, is slowly replaced by the perennial tussock grasses such as *Ischaemum laxum*, *Andropogon annulatus* etc. (Burn *et al.*, 1929).

The other approach which is suggested to manage the grassland is to improve the existing stock by mixing the grass species of annual and perennial nature along with the leguminous shrubs and the trees. The combination of grasses and the leguminous shrubs could be *Andropogon purpureo sericeus*, *Apluda varia*, *Ischaemum anthophoroides*, *Eragrostis pilosa*, *Andropogon pumilis* annual grasses, *Andropogon monticola*, *Cenchrus ciliaris*, *Andropogon caricosus*, *Andropogon pertusus*, *Iseilema wightii* of perennial grass and *Tephrosia purpurea*, *Cassia auriculata* of leguminous shrubs. The grasses such as *Andropogon monticola*, *Andropogon purpureo sericeus*, *Ischaemum anthophoroides*, *Ischaemum laxum*, *Andropogon cariocosus*, *Andropogon pumilus*, *Andropogon pertusus* etc. can make good choice as they are good fodder, drought resistant and can grow on poor soils. It is reported that the annual grasses and leguminous plants on one hand act as nurse crop for the better propagation of

Table 2

Nutritional values of some of the grass species

Grass	Crude Protein (%)	Crude Fibre(%)	Crude Fat (%)	Total Ash (%)
Cenchrus ciliaris	12	-	-	13
Apluda varia	4-6	32-40	80-1.30	9-16
Aristida funiculata	2-4	30-33	1-1.5	8-9.50
Panicum antidotale	7-13	28-40	1-1.8	7-12
Heteropogon controtus	2-7	33-38	36-1.47	8-13
Sehima nervosum	4-5	22-24	-	8-9
Dichanthium annulatum	3-9	31-39	1-2	7-14
Chrysopogon montanus	6	34	1.5	10
Iseilema laxum	3-6	35-36	1-2	6-11
Phaseolus sublobatus	13	32	1	17
Choloris gayana	18	31	1.2	12
Iseilema wightii	3-7	36-47	1-1.5	9-14
Iseilema anthophoroides	2	34	2	10

Source : ICAR Bulletin No. 35.

Nutritional values depends upon climatic and site conditions.

perennial tussock grasses and on the other hand provide green fodder in the early season and till the perennial grasses get rooted in addition to improving the soil fertility (Kulkarni, 1923). The *Andropogon purpurea-sericeus* needs special attention as it help in suppressing the *Heteropogon contortus* (spear grass) to a great extent. The grass cutting as a management tool should be practise only after November as to provide sufficient time for perennial tussock grasses for establishment. The improvement works should be continued at least for three to four years at one site. The nutritive values of some of the grass species are given in Table 2.

The special emphasis should be given in the planting of native *Zizyphus* species as it forms about 50% of the diet of the Great Indian Bustard and appreciable portion of the diet other rare wild herbivores of the area. The *Cassia auriculata* (Tarvad) attracts lot of insects which form about 15% of the Great Indian Bustard diet content hence emphasis should be given to this otherwise low profile shrubs. Also *Acacia leucophloea* leaves and pods are the only source for fodder in the pinch period (summer) to the wild fauna of the Great Indian Bustard area hence this tree should also be considered during improvement operations.

SUMMARY

The Great Indian Bustard *(Ardeotis nigriceps)* (Vigors) is an endemic species to the Indian Sub-continent. In Maharashtra it confines itself mainly to the area of Sholapur and Ahmednagar districts. The Sehima-Dichanthium type of grassland of the area requires constant management for ecological reasons and for the conservation of this rare bird along with the conservation of other biodiversity of the area. The management of grassland will reduce the man-wildlife conflict also to certain extent. The grassland of Great Indian Bustard area can be managed for betterment with the right selection of locally acclimatized suitable grass and fodder tree species and with the right selection of management practice inputs.

सोहन चिड़िया (सारंग) क्षेत्र के गवत क्षेत्रों के गवत क्षेत्रों के व्यवस्थापन का एक तरीका

ए० के० निगम, डी० के० त्यागी, एस० एम० गुजर

सारांश

सोहन चिड़िया (सांरग) भारतीय उप-महाद्वीप में ही पाया जाने वाला पक्षी है । महाराष्ट्र में यह मुख्य रूप से अहमदनगर व शोलापूर जिलों के क्षेत्रों में पाया जाता है । इन क्षेत्रों के सेहिमा-डाइकेन्थीयम प्रकार के गवत क्षेत्रों का लगातार व्यवस्थापन इस दुर्लभ पक्षी व जैवविविधता के संरक्षक के लिये जरूरी है । इन गवत क्षेत्रों का सही व्यवस्थापन मनुष्य-वन्यजीव संघर्ष को भी कम करेगा । इस गवत क्षेंत्रों की दशा में सही वृक्षों पर घास की प्रजाति लगाकर व सही व्यवस्थापन तकनीक से सुधार किया जा सकता है ।

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A NOTE ON THE RELEASE OF GOLDEN LANGUR *(PRESBYTIS GEEI,* KHAJURIA) INTO THE WILD IN TRIPURA, INDIA

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Introduction

Translocation, that is, the intentional release of animals into the wild to establish, re-establish, or augment an existing population, is coming into increasing use (Kleiman, 1989), as one of the most important conservation measures in face of the fast depletion of natural habitat of wild animals.

Among approximately 175 species of primates, barring few well-monitored reintroductions, most releases of primates have been unintentional, unmonitored or both. Few well known examples are those of Olive baboons (*Papio anubis*), Orangutans (*Pongo pygmaeus*; Aveling and Mitchell, 1982), Chimpanzees (*Pan troglodytes*; Brewer, 1978) and Golden lion tamarins *Leontopithecus rosalia*, (Dietz, 1985; Konstant and Mittermeier, 1982).

Only two primates examples are available of Indian species namely, the lion-tailed macaque (*Macaca silenus*) whose captive-bred population has been released into semi-captivity at the New York Zoological Society's endangered breeding station and on St. Catherine's island off the coast of Georgis, and the Rhesus macaque (*Macaca mulatta*). This paper reports on a third such example (and the first among colobines) in India and examines its utility as one of the alternative conservation strategies for primates conservation.

The Golden Langur

The distribution of golden langur (herein after referred as langur) is restricted to areas along Indo-Bhutan border from east of Sankosh in Bhutan to the west of Manas river in India (Mukherjee *et al.*, 1993). The species is well distributed in Bhutan but, only a small population of 34 groups (355 langurs) are reported in Goalpara, Kamrup and Dhubri Districts in Assam (Mukherjee, 1981). Many zoos in the country have captive population of this species.

Golden Langur in Tripura

Tripura has seven non-human primate species, namely *Trachypithecus phayrei, Trachypithecus pileata, Macaca mulatta, Macaca nemestrina, Macaca arctoides, Hylobates hoolock* and *Nycticebus coucang* (Gupta, in press). There are no records to suggest the presence of naturally occurring wild population of golden langurs in this State.

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One pair of langurs was brought from Assam in February 1988 for Sepahijala zoo, located about 30 kms south of Agartala the capital town of Tripura. With continued supply their number increased to 15, comprising of 5 adult males and 10 adult females. Of this captive stock, the State Forest Department released ten langurs in the wild in two batches of four (1 adult male and 3 adult females) and six (1 adult male, 5 adult females) each in Sepahijala Wildlife Sanctuary and Trishna Wildlife Sanctuary, respectively, in June 1988. However, no systematic monitoring thereafter has been done at either of the release sites.

Current status of released population

1. *In Trishna WLS* : The released group of langurs could not be located in Trishna WLS during two surveys conducted in December 1993. Inquiries made with the local staff were also of no use since most of them had joined well after the release. More surveys are being undertaken shortly in future.

2. *In Sepahijala WLS* : The release in Sepahijala WLS was made within the zoo boundary and the site was well protected from hunting and natural predators. Therefore, the released group could be located easily.

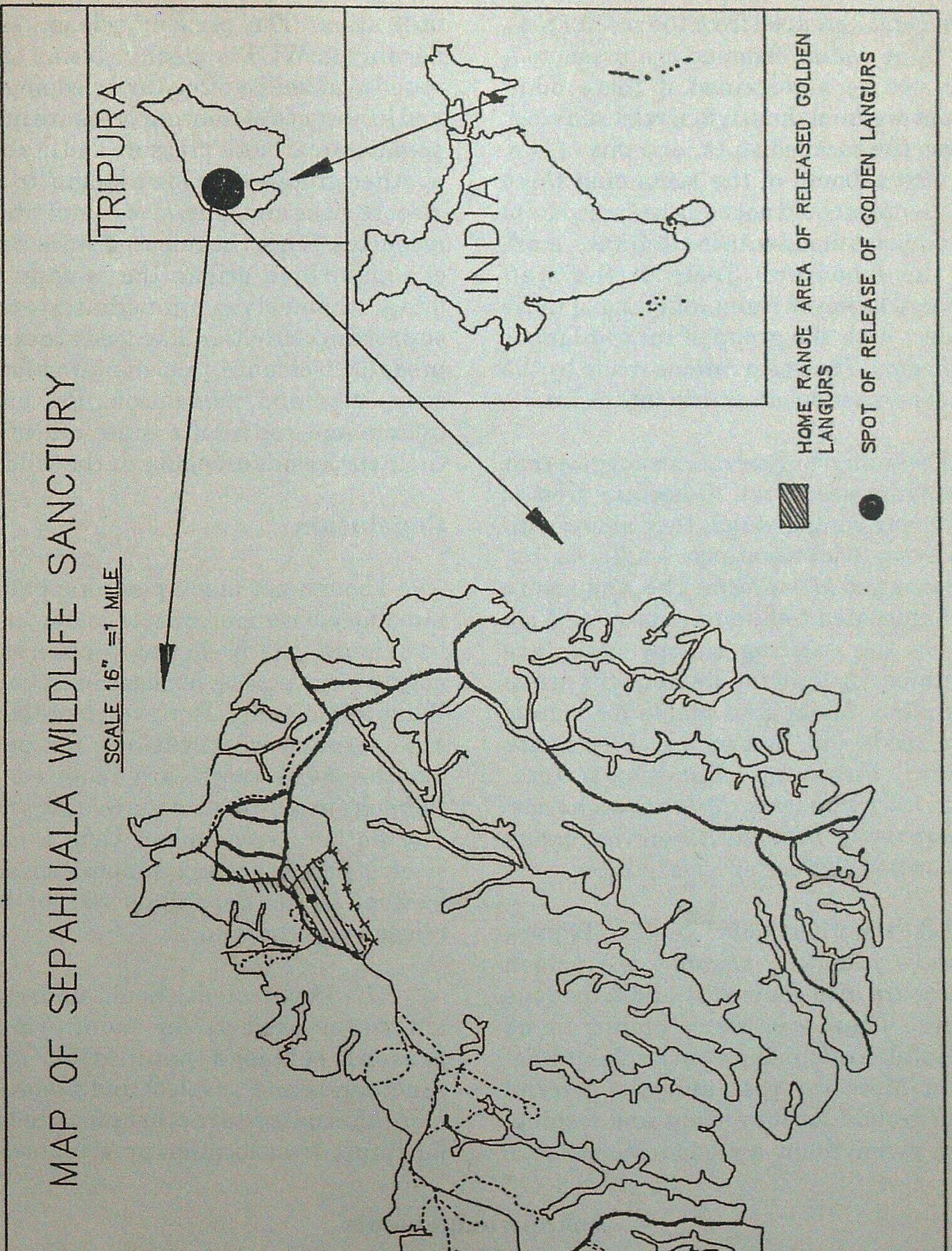
The records maintained on the captive population of golden langurs in the zoo indicates that three adult females escaped from the captivity in January 1991 and joined with the released groups. But, the present group composition of the released population of langurs (Table 1), indicates that of the total 6 adult females (3 released

Table 1

Group composition of released population of Golden langur in Tripura since 1988

Name of sanctuary	Original released stock			Future addition in original stock			Died (D) or missing (M)			Current status	
	Date	No.	A/S	Date	No.	A/S	No.	A/S	Cause	No.	A/S
Trishna WLS	June 1988	1	AM	Not Known			Not Known			Not Known	
		4	AF								
Sepahijala WLS	June 1988	1	AM	Nil			Nil			1	AM
		3	AF	Jan. 1991	3	AF escaped from captivity	3	AF	Not known	3	AF
				1992	1	INF new birth	-	-	-	1	SAM
				1993	1	INF new birth	-	-	-	1	INF
				1993	1	INF new birth	-	-	-	1	INF
				Jan. 1994	1	INF new birth	1	INF (D)	Not known	-	-

A/S = Age/Sex, AM = Adult male, AF = Adult female, SAM = Sun-adult male, INF = Infant, WLS = Wildlife Sanctuary.


MAP OF SEPAHIJALA WILDLIFE SANCTURY
SCALE 16" =1 MILE
TRIPURA
INDIA
▨ HOME RANGE AREA OF RELEASED GOLDEN LANGURS
● SPOT OF RELEASE OF GOLDEN LANGURS
N

in 1988 and 3 escaped from the zoo in 1991), only three adult females are present. It could not be ascertained if these adult females are from the original released stock or from the escaped stock, or a mix of two. The whereabouts of the remaining three adult females could not be ascertained from the enquiries made with local officers, staff, and the labourers. Some of the staff members however claim mingling of those females with the group of capped langur (*T. pileata*). The observations made by the authors do not substantiate this claim.

Preliminary observations suggest that the langurs use about 20 hectare area as their home range, which they share with other sympatric primate species; *T. phayrei, T. pileata* and *M. mulatta*. The langurs are well habituated to human presence. Wide gaps in the existing canopy cover are negotiated for foraging by frequent use of the ground. Major food plants for leaves, fruits, seeds and, flowers are *Terminalia bellerica; Ficus* spp.; *Burserra serrata; Acacia auriculiformis; Mikenia scandans; Delonia regia; Dillenia pentagyna;* many unidentified climber species; etc.

Like the other two colobines in Tripura (*T. phayrei* and *T. pileata*), the golden langurs are also generalist and folivorous feeders. They are, thus, bound to be successful in colonising even a sub-optimal habitat. Moreover, their ability to descend on the ground for movement and feeding, would given them an edge in resource utilisation. The present release site in Sepahijala WLS is ideal in terms of year round availability of food and sleeping sites, and in absence of hunting pressure in large predators and biotic pressure and in absence of other groups of golden langur to avoid disease risks and excessive competition for resources.. Since the released stock was not of captive-bred origin, the langurs could adapt themselves immediately to life supporting activities, like food acquisition, predator avoidance, proper interaction with conspecies and navigation. Presence of infants and sub-adults is an indication of their successful breeding in the wild.

Conclusion

Though not much planning had gone into the release operation of golden langurs in Tripura, the preliminary observations suggest its success, at least in Sepahijala Wildlife Sanctuary. However, more surveys and detailed observations for several months, even years, are required for a thorough assessment of the release process. The authors recommend that a captive stock of proper age/sex composition should be kept in the Sepahijala zoo for future release into the wild.

The Department should undertake a long-term project, for monitoring the present released population in two sanctuaries and to select and prepare few more alternate site in other protected areas for future translocation programmes.

Acknowledgements

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SUMMARY

There are no records of presence of naturally occurring wild population of Golden Langurs (*Presbytis geei*, Khajuria) in Tripura. Therefore, their operation for release in Wildlife Sanctuaries in the State has been suggested for captivity.

त्रिपुरा राज्य, भारत के जंगलों में सुनहरा लगुंर (प्रेसबायटिस *गीआई*, खजूरिया) छोड़ने के विषय में एक टिप्पणी

ए० के० गुप्त व एस० के मुखर्जी

सारांश

त्रिपुरा राज्य में प्रकृतितः जंगली अवस्था में सुनहरे लंगूर (*प्रेसबायटिस गीआई*, खजूरिया) मिलने का कोई उल्लेख उपलब्ध नहीं है । इसलिए वन्यप्राणी अभयारण्यों में बंदी अवस्था में रखने के लिए इसे राज्य में छोड़ने के कार्य का सुझाव दिया गया है ।

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NUTRITIVE VALUES OF SOME LESSER KNOWN HERBIVORE FOODS FROM MELGHAT TIGER RESERVE (MAHARASHTRA)

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Introduction

The mammalian herbivores consume directly stems, leaves, flowers, fruits, seeds or even bark or roots of a large number of plant species. The choice of plant species or even specific part/parts and stage of growth used as a feed-stuff by herbivores is determined by several factors like palatibility, availability etc. At times certain materials are used as fodder because of prevailing compulsive conditions of the habitat. Melghat Tiger Reserve is an abode of sizeable population of wild mammalian herbivores like Gaur, Sambar, Nilgai, Sloth bear, Cheetal, Wild boar etc. Some tribal villages are dotted all over the buffer zone of this reserve and domestic cattle from these habitations add to herbivore population.

Major part of the territory is covered by Tropical Dry Deciduous Forest of a good status. *Tectona grandis* is dominant tree species. Different forests associations allow a nice growth on forest floor, dominated by tall, luxuriantly growing grass species, certain legumes and other herbs as associates. Shrub layer is also well represented. Thus there is ample food material in green state for wild herbivores during July to November. From December onwards, the herbivores feed mainly on dry biomass of grasses and other forbs, fallen leaves of trees, tender shoots of some shrubs or flowers, fruits and even bark of some trees. May-June are somewhat harder months in getting food as herbivore population gets concentrated around water holes. The intensity of harder conditions is more especially when some contiguous forest compartments experience fire hazard.

Good information is available regarding feeding habits of wild herbivores with Melghat Tiger Reserve. Sen *et al.* (1978) and many other workers have determined the nutritive values of many feeds. However, there are several other materials for which no such data is available. A study is undertaken to determine the chemical composition of such herbivore foods. Major nutrition components are only considered.

Materials and Methods

Eight plant materials were selected. Samples after collection were dried in an oven upto the constant weight. Materials were then subjected to analysis for determining nutritive parameters like % crude protein, % crude fat, crude fibre, soluble carbohydrates NFE (Nitrogen Free

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Extract) and total carbohydrates (including ash). The values were obtained using methodology developed by Henneberg and co-workers in 1969 termed as Weende system of proximate analysis. NFE was determined using method developed by AOAC (Anon. 1970). The value of ash content could not be determined separately for want of necessary facility.

Results and Discussion

Nutritive values obtained from materials studied are given in Table 1.

The availability of the materials selected for this study varies in relation to quantum, space and period of the year. Food choice of herbivores towards these

Table 1

Nutritive values of herbivore foods studied

Plant Species	Dry matter (%)	Crude protein (%)	Crude fat (%)	Crude fibre (including ash)	Soluble carbohydrates (NFE) (%)	Total carbohydrates (including ash) (%)
Heteropogon ritchiei (Terminal vegetative aerial part)	-	14.38	4.0	45.0	36.4	81.4
Pseudanthistiria hispida (Aerial shoots)	-	11.75	2.0	43.0	43.2	86.2
Chloris dolicostachya (Aerial vegetative parts)	-	15.44	2.0	40.0	42.6	82.6
Clitoria biflora (Tender upper shoot part)	-	20.63	7.5	39.0	32.9	71.9
Zizyphus xylopyra (Leaves)	-	23.75	3.5	20.0	52.8	72.8
Flacourtia indica (Leaves)	-	21.69	11.5	15.5	51.3	66.6
Milletia auriculata (Leaves and young stems)	-	16.69	9.5	37.0	36.8	73.8
Securinega virosa (Young leaf bearing shoots)	-	23.13	8.5	27.5	35.9	63.4

materials also varies. Melghat Tiger Reserve is one of the few areas in Deccan Peninsula where the grass *Heteropon ritchiei* grows luxuriantly and is gregarious in certain sectors. The top portions especially before flowering are eaten by Gaur, Sambar, domestic cattle etc. Large biomass is left over on drying of this grass and is food during summer.

Pseudanthistiria hispida grows in many areas forming pure patches or in association with other grasses. This grass is more significant as a food for domestic cattle as it occupies somewhat open flat tops with medium grade substratum and experiencing mild grazing pressure in the vicinity of villages from buffer zone. *Chloris dolichostachya* occurs mostly in the interior of Reserve on moist, shaded forest floors of rich substratum. It also grows on mud flats along river and stream banks. This grass comes to maturity somewhat late and provides green material to herbivores till February. As expected, the three grass species on analysis show higher content of total carbohydrates (including ash) as compared to other five non-grass species.

Clitoria biflora is by far the most common legume growing amongst tall grasses on forest floor throughout the territory of this Reserve. Plants of this species come up quite early after first monsoon rains. Uppermost tender part of the shoot of this herb is invariably devoured by herbivores. Therefore, these plants show decrease in growth and subsequent reproduction rather than outright death. Older lower part of this plant bearing pods are avoided as food by herbivores.

Milletia auriculata is a common liane occurring throughout. Its leaves and thin stems are eaten by Gaur, domestic cattle especially, during April to June period when other food materials become scarce. *Zizyphus xylopyra* and *Flacourtia indica* are fairly common in most localities. Leaves of these species is a food of herbivores. *Securinega virosa* shows gregarious shrubby undergrowth in many localities of this Reserve. Young shoots of this plant assume significance as food material of herbivores in June and July after good early monsoon rains followed by a long dry spell. Incidentally, amongst the materials studied, young shoots of *Securinega virosa* contain higher % of crude protein and crude fat.

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SUMMARY

A study was undertaken to determine nutritive values of eight lesser known plant foods of wild herbivores like Gaur, Sambar etc. from Melghat Tiger Reserve. These materials are also the food of domestic cattle from tribal villages located in buffer zone of this Reserve. The main

components of proximate analysis of food-stuffs like crude protein, crude fat, crude fibre, soluble carbohydrates (NFE) and solule carbohydrates (including ash) were estimated by Weende system of proximate analysis. All the forage materials studied namely, *Heteropogon ritchiei, Pseudanthistiria hispida, Chloris dolichostachya, Clitoria biflora, Milletia auriculata, Zizyphus xylopyra, Flacourtia indica, Securinega virosa* are significant floristic components found in wider area of Melghat Tiger Reserve. The three grass species studied contain higher % of carbohydrates, whereas plant parts of *Securinega virosa* used as feed-stuff by herbivores contain high % of crude protein.

मेलघाट व्याघ्र प्रकल्प के परिक्षेत्र में वास्तव्य करने वाले वनस्पति -आहारी पशुओं के कुछ कम जानकारी वाले खाद्यान्नों के पौष्टिक मानोंका निर्धारण

व्ही० आर० देशमुख व एम० ए० ढोरे

सारांश

मेलघट व्याघ्र प्रकल्प के परिक्षेत्र में गौर, सांबर, नीलगाय, चीतल, भालू जैसे वनस्पति - आहरी पशुओं का वास्तव्य है । साथ ही में बफर क्षेत्र में स्थित छोटे आदिवासी देहातों में वनस्पति - आहरी पालतु जानवर भी हैं । पशुओं की खाद्यान्नों की पसन्द कई तत्वों पर निर्धारित होती हैं । कई वनस्पति प्रजाति के स्तंभ, पर्ण, फूल, फल, बीज इन पशुओं का पोषण करते है । इस अभ्यास के लिये मेलघाट व्याघ्र प्रकल्प के जंगल में विपुल मात्रा में उपलब्ध तथा वनस्पति आहारी पशुओं के आहार में निश्चित रूप से महत्व रखने वाली आठ वनस्पति प्रजाति जैसे की *हेटरोपोगोन रिची, सुडानथिस्टिरिया हिस्पीडा, क्लोरिस डॉलीकोस्ट कीया, क्लायटोरिया बायफ्लोरा, मिलेशिया आरिक्युलेटा, झिझीफस ज़ालोपायरा फ्लॉकाअरशिया इण्डिका* व *सेक्युरिनेगा व्हिरोसा* लिया गया । यह वनस्पति के खाद्य संघटन की जानकारी उपलब्ध नहीं । यह अभ्यास में पशुओं द्वारा भोजन में आनेवाले इन वनस्पति के अंगों में उपलब्ध क्रुड प्रोटीन, क्रुड फॅट , क्रुड फायबर, सोल्युबल कार्बोहायड्रेट्स तथा संपूर्ण कार्बोहायड्रेट्स (अंश के साथ) जैसे पौष्टिक मानोका निर्धारण किया गया । अभ्यासित तीन घास प्रजाति के अंगों में कार्बोहायड्रेट्स ज्यादा मात्रा में स्थित है । क्रुड प्रोटीन का प्रमाण *सेक्युरिनेगा व्हिरासा* में अधिक है ।

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BLACK BUCK DAMAGE - AS A PROBLEM FOR SANCTUARY MANAGEMENT IN BUSTARD SANCTUARY KARERA

R.D. SHARMA

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Introduction

Bustard Sanctuary Karera comprises of 202.21 km^2 between Mahuar and Sindh rivers. There is no forest land inside the sanctuary. Out of the 202.21 km^2 of land 55.55 km^2 is revenue land and rest is owned by Bhumiswamis. In all, there are 32 villages inside the sanctuary with a total human population of 22,763 and cattle population of 36,214.

The sanctuary area is mostly flat with gentle undulations. There are a few hills. The sanctuary has many seasonal streams finally draining either in irrigation tanks or rivers. These streams get dried up by the end of September/October except for small pools in which water remains for a few more months. There are a few water tanks like famous Dihaila Jheel. Water in irrigation tanks like Berkhera remains throughout the year. Dihaila dries up in summer except for a few pools near Rajpur and Dihaila villages.

Zizyphus rotundifolia, the most dominant plant species, is remarkable feature of the sanctuary.

At the time of declaration of sanctuary for the conservation of rare and threatened species, the Great Indian Bustard (*Ardeotis nigriceps*) in 1981, the number of black-bucks was only 100 to 150. The regular census of black-buck in the sanctuary was carried out from 1984 onwards. The number of black buck estimated yearwise is as follows (Table 1).

Table 1

Year	No. of Black -Buck
1984	187
1985	306
1986	456
1987	765
1988	1169
1989	1923
1990	2138
1991	2626
1992	3005

Dramatic increase in the number of black-bucks has posed a serious problem for agriculturists as well as for sanctuary management.

Assessment of Extent of Damage to Cultivated Crops

By the year 1989, the problem of crop raiding by black-bucks became so acute that the hostile villagers were not responding to sanctuary management at all and they were so non-cooperative that they did not allow to carry out quantitative studies to assess the extent of damage. Few people who allowed to lay out sample plots in their fields also disturbed the plots within a few days and did not allow to complete the study. Therefore, only occular survey to assess the damage could be made. The result of the survey are tabulated in Table 2.

Abstract of damage of various crops calculated from the above is shown in Table 3.

Thus *Lens esculenta* with 17.67 per cent damage is most damaged crop which is followed by *Brassica campestris*, *Eruca sativa* and *Cicer arietinum* with 13.15, 12.69 and 12.01 per cent damage respectively. *Triticum vulgare* is least damaged crop with only 10.97 per cent damage.

Black-buck Damage Problem and Bustard Conservation

The Black-buck damage problem has given rise to many factors inimical to bustard conservation.

(1) The black bucks in the sanctuary have occupied the same territories which were being used by the bustard. Turkani, Behgawan, Karowaah, Berkhera etc. the most important bustard areas are also the most important black buck areas. Thus, there is now a competition between black bucks and bustards for area use.

(2) In order to protect the crops from black buck depredations, the villagers have started staying during night in huts constructed near their fields. Thus bustards now have less fields to forage.

(3) Because of comparatively more damage to *Cicer arietinum* and *Eruca sativa* the villagers have started growing more of *Triticum vulgare*. This has been especially noticed in Dihaila, Rajpur and Kharicha villages situated near Turkani, the most important area for bustard as well as for black bucks. In winters when insect population is very low the *Cicer arietinum* and *Eruca sativa* constitute the only palatable diet for bustard. Due to this change in crop pattern, the bustards are leaving the sanctuary area in search of food as there is no food for them in winter. The bustards have been observed outside the sanctuary area at many places.

(4) The female bustard requires secluded and undisturbed place for nesting. Therefore, the livestock grazing is banned in important nesting areas e.g. Turkani but the black bucks remain in the nesting areas in the breeding season. It may become the most dangerous factor affecting the successful breeding of the bustard. They may also trample the eggs, or frequently disturb the eggs resulting in the death of embryo. Their presence itself in the nesting area is a great disturbing factor for the female bustard. Under such circumstances the bustards having a tendency for nest-site fidelity, are being forced to change the nesting sites.

(5) Because of the damage to the crop by black buck, the villagers are turning inimical to the concept of sanctuary and bustard conservation. The bustard is now not enjoying praise amongst villagers as they understand that creation of bustard sanctuary has posed the problem of black buck depredation on their crops. The villagers inside the sanctuary as well those outside are no more interested in showing bustard to sanctuary management.

The black bucks are, therefore, not only a problem for farmers crop but by changing the minds of the villagers due to loss to their crops, are responsible for their hostility to the

Table 2

Assessment of Crop Damage by Black-bucks

Village	Crop	Total area of the crop in affected areas of the village (ha)	Area of the crop actually damaged (ha)	Percentage of damage
1. Behgawan	Gram *(Cicer arietinum)*	43.6	6.2	14.22
	Wheat *(Triticum vulgare)*	25.5	3.6	14.11
	Lentil *(Lens esculenta)*	1.6	0.2	12.50
	Taramira *(Eruca sativa)*	3.4	0.6	17.64
	Mustard *(Brassica campestris)*	7.1	1.1	15.49
2. Baraua	*Cicer arietinum*	4.2	0.5	11.90
	Triticum vulgare	9.6	1.1	11.45
	Lens esculenta	0.4	0.05	12.50
	Eruca sativa	2.8	0.3	10.71
	Brassica campestris	1.7	0.15	8.82
3. Mudeni	*Cicer arietinum*	4.4	0.6	13.63
	Triticum vulgare	9	0.83	9.22
	Lens esculenta	0.4	0.08	20
	Eruca sativa	-	-	-
	Brassica campestris	-	-	-
4. Kharicha	*Cicer arietinum*	26.6	3.25	12.21
	Triticum vulgare	29.0	2.45	8.44
	Lens esculenta	2.8	0.60	21.42
	Brassica campestris	1.0	0.15	15
	Eruca sativa	0.4	0.05	12.50
5. Gadhai	*Cicer arietinum*	4.8	0.46	6.58
	Triticum vulgare	16.0	1.57	9.81
	Lens esculenta	-	-	-
	Brassica campestris	-	-	-
	Eruca sativa	1.20	0.04	3.33
6. Jhanda	*Cicer arietinum*	25.1	2.58	10.27
	Triticum vulgare	22.6	0.67	2.96
	Brassica campestris	-	-	-
	Lens esculenta	0.2	0.03	15
	Eruca sativa	-	-	-
7. Niwari	*Cicer arietinum*	11.8	1.65	13.98
	Triticum vulgare	22.6	2.6	11.50
	Lens esculenta	0.2	0.03	15
	Brassica campestris	-	-	-
	Eruca sativa	-	-	-
8. Berkhera	*Cicer arietinum*	42.4	4.34	10.23
	Triticum vulgare	70.0	9.6	13.71
	Lens esculenta	-	-	-
	Eruca sativa	-	-	-
	Brassica campestris	1.6	0.1	6.25

Table 3.

Assessment of Crop damage by Black Bucks

Crop	Villages	Total area of the crop in affected areas of the villages (ha)	Area of the crop actually damaged (ha)	Percentage of damage
Cicer arietinum	Behgawan, Baraua, Mudeni, Kharicha, Gadhai, Jhanda, Niwari, Berkhera	162.90	19.58	12.01
Triticum vulgare	Behgawan, Baraua, Mudeni, Kharicha, Gadhai, Jhanda, Niwari, Berkhera	204.30	22.42	10.97
Lensesculenta	Behgawan, Baraua, Mudeni, Kharicha, Jhanda, Niwari	5.60	0.99	17.67
Erucasativa	Behgawan, Baraua, Kharicha, Gadhai	7.80	0.99	12.69
Brassicacampestris	Behgawan, Baraua, Kharicha, Berkhera	11.40	1.50	13.15

concept of bustard conservation, Black-bucks have also emerged as a most important factor causing damage to bustard and its habitat in many ways. It appears, nature is not able to adjust black-bucks, the hoofed animals and the ground breeder bustard together.

Discussion

Dramatic increase in the number of black- bucks has posed a serious problem to agriculturists as well as for bustard management. The survey carried out to assess the extent of black-buck damage has shown that the *Lens esculenta* with 17.67 per cent damage is most damaged crop which is followed by *Brassica campestries*, *Eruca sativa* and *Cicer arietinum* with 13.15, 12.69 and 12.01 percentage damage respectively. The black-bucks are not only a problem of agriculture but are also a great danger to bustard conservation.

SUMMARY

Dramatic increase in the number of black-bucks has posed a serious problem to agriculturists as well as for bustard management. An extensive survey has been made to assess the extent of damage to crops in various 8 affected villages. The study investigates that Lentil *(Lens esculenta)* is the most damaged crop which is followed by mustard *(Brassica campestris)*, Taramira *(Eruca sativa)* and Gram *(Cicer arietinum)*. Wheat *(Triticum vulgare)* is the least damaged crop.

The black-buck damage problem has given rise to many factors inimical to bustard conservation. The black-bucks are not only a problem for farmer's crop but, by changing the minds of the villagers due to loss to their crops, are also responsible for their hostility to the concept of bustard conservation. Black-bucks have also emerged out as a most important factor causing damage to bustard and its habitat. It appears, nature is not able to adjust black-bucks - the hoofed animals and the ground breeder bustard together.

कृष्णसार द्वारा हानि-सारंग अभयारण्य करेरा के अभयारण्य प्रबन्ध की समस्या के रूप में

आर० डी० शर्मा

सारांश

कृष्णसार मृगों की संख्या में हुई नाटकीय वृद्धि ने किसानों तथा सारंग प्रबन्ध दोनों के लिए गम्भीर समस्या खड़ी कर दी है । इनसे प्रभावित हुए आठ गांवों में फसलों को पहुँची हानि के आकलन के लिए विस्तृत सर्वेक्षण किया गया है । इस अध्ययन से पता लगा है कि सबसे अधिक हानि सामान्य मसूर (लेंस एस्कुलेंटा) और उसके बाद क्रमशः कम होती सरसों (*ब्रासिका कैम्पेस्ट्रिस*) तारामिरा (*एरुका सेटाइवा*) चना (*सिसेर एरिटिनम*) की फसलों को पहुँची है । गेहूँ (ट्रीटिकम वल्गेर) को सबसे कम हानि हुई है ।

कृष्णसार मृगों द्वारा हानि की पड़ताल अनेक कारक सामने लाई है जो सारंग संरक्षण के शत्रु हैं । कृष्णसार मृग किसानों के लिए ही समस्या नहीं बने, परन्तु उनकी फसलों को हानि पहुँचने के फलस्वरूप ग्रामीणों का मन बदल जाने के कारण, सारंगों का संरक्षण करने के विचार के प्रति उनकी शत्रुता के लिए भी उत्तरदायी हैं । कृष्णसार मृग भी बड़े महत्वपूर्ण कारक के रूप में सामने आए हैं और सारंग तथा इसके प्राकृत्तावास को हानि पहुँचाते हैं । ऐसा प्रतीत होता है कि प्रकृति खुरों वाले जानवर कृष्णसार मृग और भूमि की वनस्पतियों से घोषित होने वाले सारंग दोनों को एक साथ सम्भालने में समर्थ नहीं है ।

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CHECK - LIST OF BIRDS OF INDIRA GANDHI NAHAR PROJECT STAGE - II (RAJASTHAN)

R.G. SONI*

Introduction

Indira Gandhi Nahar Project Stage-II Area covers approximately 70 km wide strip, along Indo-Pak border, in Bikaner, Jaisalmer, Jodhpur and Barmer districts. This area is, by and large, an undulating sandy tract having high sand dunes. Geoclimatically it is a very difficult area for human, animal and plant life. The rainfall is very erratic and meagre (about 100 mm), maximum temperature in summer goes upto 53°C and minimum in winter down to 0°C. Almost continuous sand-storms from March to August make things worse by burying or uprooting.

The Flora

The natural Flora comprises of very few stunted trees of Khejari (*Prosopis cineraria*), Jal (*Salvadora* spp.), Ber (*Zizyphus* spp.), Babool (*Acacia nilotica*) etc. Among shrubs important ones are Phog (*Calligonum polygonoides*), Kheemp (*Leptadenia pyrotechnica*), Aakra (*Calotropis procera*), Kair (*Capparis decidua*), Senia (*Crotalaria burhia*), Bui (*Aerua pseudotomentosa*), Ber (*Zizyphus nummularia*) etc. Important grasses are Sevan (*Lasiurus sindicus*), Dhaman (*Cenchrus* spp.), Murath (*Panicum turgidum*), Ganthilo (*Dactyloctenium sindicum*), Buraro (*Cymbopogon jawarancusa*) etc.

The Site

This arid ecosystem has been supporting, besides omnipresent birds like Bulbuls, Doves, Shrikes, Babblers etc., Sandgrouse, Bustards, Larks and a host of birds of prey. A few village tanks also attracted migratory water birds and Imperial Sandgrouse, Demoiselle Crane, Houbara bustard etc. With the arrival of canal water in eighties this area has become very dynamic, bringing in rapid and enormous changes in biodiversity of the area. Besides irrigated agriculture on a large area, afforestation along canals and on sand dunes is also being done on a large scale. Various species planted are : *Prosopis cineraria, Tecomella undulata, Zizyphus mauritiana, Acacia nilotica, Acacia tortilis, Dalbergia sissoo, Eucalyptus camaldulensis, P. juliflora, Calligonum polygonoides, Lasiurus sindicus* etc. Total area of stage-II is 25 lac hectare out of which 10 lac hectare will become command. Afforestation activity on 35000 hectare has already been done, it is hoped that about 50000 hectare more will be planted in next five years.

It will not be wrong to say that I.G.N.P. Stage-II is a paradise for scientists interested in tudies of biodiversity changes. During the course of my inspections of afforestation works for last five years (1988-93) I had seen 170 species of birds in the

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I.G.N.P. Stage-II area which I am listing below. It certainly needs to add some species which I must have missed seeing or identifying. I think in due course of time many other species will also be found here; the stage-I plantations will act as corridore for their movement from Punjab, Haryana and even Pakistan.

List of Birds

Podicipedidae

1.	*Podiceps ruficolis* (Little Grebe)	O +

Phalacrocoracidae

2.	*Phalacrocorax carbi* (Large Cormorant)	O +
3.	*Phalacrocorax niger* (Little Cormorant)	C +

Ardeidae

4.	*Ardea cinerea* (Grey Heron)	R +
5.	*Ardea purpurea* (Purple Heron)	R +
6.	*Ardeola grayii* (Pond Heron)	C +
7.	*Bubulcus ibis* (Cattle Egret)	C +
8.	*Egretta intermedia* (Median Egret)	O +
9.	*Egretta garzetta* (Little Egret)	C +
10.	*Botaurus stellaris* (Bittern)	R +

Ciconiidae

11.	*Mycteria leucocephala* (Painted Stork)	R +
12.	*Ciconia episcopus* (Whitenecked Stork)	R +
13.	*Ciconia nigra* (Black Stork)	R

Threskiornithidae

14.	*Pseudibis papillosa* (Black Ibis)	C +
15.	*Platalea leucorodia* (Spoonbill)	O +

Phoenicopteridae

16.	*Phoenicopterus roseus* (Flamingo)	R +
17.	*Phoeniconaias minor* (Lesser Flamingo)	R +

Anatidae

18.	*Anser indicus* (Barheaded Goose)	R + M
19.	*Tadorna ferruginea* (Brahminy Duck)	R + M
20.	*Anas acuta* (Pintail)	O + M
21.	*Anas crecca* (Common Teal)	O + M
22.	*Anas poecilorhyncha* (Spotbilled Duck)	O +
23.	*Anas platyrhynchos* (Mallard)	R + M
24.	*Anas strepera* (Gadwall)	C + M
25.	*Anas querquedula* (Garganey Teal)	O + M
26.	*Anas clypeatay* (Shoveller)	C + M
27.	*Aythya ferina* (Common Pochard)	O + M
28.	*Aythya fuligula* (Tufted Pchard)	O + M
29.	*Sarkidiornis melanotos* (Comb Duck)	R +

Accipitridae

30.	*Elanus caeruleus* (Blackwinged Kite)	O
31.	*Pernis ptilorhyncus* (Crested Honey Buzzard)	R +
32.	*Milvus migrans* (Pariah Kite)	C

33.	*Accipiter badius* (Shikra)	O +
34.	*Accipiter nisus* (Sparrow-Hawk)	R +
35.	*Buteo buteo* (Desert Buzzard)	O
36.	*Butastur teesa* (White-eyed Buzzard)	R +
37.	*Aquila rapax* (Tawny Eagle)	C
38.	*Sarcogyps calvus* (King Vulture)	O
39.	*Aegypius monachus* (Cinereous Vulture)	R M
40.	*Gyps fulvus* (Geriffon Vulture)	O M
41.	*Gyps indicus* (Indian Longbilled Vulture)	R
42.	*Gyps bengalensis* (Whitebacked Vulture)	A
43.	*Neophron percnopterus* (Egyptian Vulture)	C
44.	*Circus cyaneus* (Hen-Harrier)	O M
45.	*Circus macrourus* (Pale Harrier)	R M
46.	*Circus melanoleucos* (Pied Harrier)	R M
47.	*Circus aeruginosus* (Marsh Harrier)	O M
48.	*Circaetus gallicus* (Short-toed Eagle)	O
49.	*Buteo lagopus* (Roughlegged Buzzard)	R

Falconidae

50.	*Falco biarmicus jugger* (Laggar Falcon)	O
51.	*Falco subbuteo* (Hobby)	R
52.	*Falco tinnunculus* (Kestrel)	O

Phasianidae

53.	*Francolinus francolinus* (Black Partridge)	R +
54.	*Francolinus pondicerianus* (Grey Partridge)	C
55.	*Perdicula asiatica* (Jungle Bush Quail)	R +
56.	*Pavo cristatus* (Common Peafowl)	C +

Gruidae

57.	*Grus grus* (Common Crane)	O M
58.	*Anthropoides virgo* (Demoiselle Crane)	O M

Rallidae

59.	*Gallinula chloropus* (Indian Moorhen)	C +
60.	*Porphyrio porphyrio* (Purple Morrhen)	C +
61.	*Fulica atra* (Coot)	C +

Otidiae

62.	*Choriotis nigriceps* (Great Indian Bustard)	R
63.	*Chlamydotis undulata* (Houbara)	R M

Jacanidae

64.	*Hydrophasianus chirurgus* (Pheasant-tailed Jacana)	O +

Recurvirostridae

65.	*Himantopus himantopus* (Blackwinged Stilt)	A +
66.	*Recurvirostra avosetta* (Avocet)	O +

Glareolidae

67.	*Cursorius cursor* (Creamcoloured Courser)	O
68.	*Cursorius coromandelicus* (Indian Courser)	R
69.	*Glareola pratincola* (Collared Pratincole)	

Charadriidae

70.	*Vanellus leucurus* (Whitetailed Lapwing)	O M
71.	*Vanellus indicus* (Red-wattled Lapwing)	A +
72.	*Charadrius dubius* (Little Ringed Plower)	O +
73.	*Numenius arquata* (Curlew)	R + M
74.	*Limosa limosa* (Blacktailed Godwit)	R + M
75.	*Tringa totanus* (Red Shank)	R + M
76.	*Tringa ochropus* (Green Sandpiper)	O + M
77.	*Tringa glareola* (Wood Sandpiper)	O + M
78.	*Tringa hypoleucos* (Common Sandpiper)	O +
79.	*Gallinago gallinago* (Common Fantail Snipe)	O + M
80.	*Calidris minuta* (Little Stint)	O + M
81.	*Philomachus pugnax* (Ruff and Reeve)	C + M

Laridae

82.	*Larus brunnicephalus* (Brownheaded Gull)	R + M
83.	*Chlidonias hybrida* (Whiskered Tern)	R + M
84.	*Sterna aurantia* (Indian River Tern)	R +

Pteroclididae

85.	*Pterocles exustus* (Indian Sandgrouse)	C
86.	*Pterocles orientalis* (Imperial Sandgrouse)	R

Columbidae

87.	*Treron phoenicoptera* (Yellowlegged Green Pigeon)	R +
88.	*Columba livia* (Blue Rock Pigeon)	A +
89.	*Streptopelia decaocto* (Ring Dove)	A +
90.	*Streptopelia senegalensis* (Little Brown Dove)	A +

Psittacidae

91.	*Psittacula krameri* (Roseringed Parakeet)	C +

Cuculidae

92.	*Clamator jacobinus* (Pied Crested Cuckoo)	R + M
93.	*Eudynamys scolopacea* (Koel)	R +
94.	*Centropus sinensis* (Crow-Pheasant)	O +

Strigidae

95.	*Bubo bubo* (Great Horned Owl)	R +
96.	*Athene brama* (Spotted Owlet)	C+
97.	*Asio flammeus* (M) (Shorteared Owl)	R

Caprimulgidae

98.	*Caprimulgus europaeus* (European Nightjar)	R + M
99.	*Caprimulgus asiaticus* (Common Indian Nightjar)	O +

Apodidae

100.	*Apus affinis* (House Swift)	O +

Alcedinidae

101.	*Ceryle rudis* (Pied Kingfisher)	R +
102.	*Alcedo atthis* (Small Blue Kingfisher)	R +
103.	*Halcyon smyrnensis* (Whitebreasted Kingfisher)	C +

Meropidae

104.	*Merops superciliosus* (Bluecheeked Bee-eater)	A + M

105. *Merops orientalis* C +
(Green-Bee-eater)

Coraciidae
106. *Coracias garrulus* O + M
(European Roller)
107. *Coracia benghalensis* C +
(Indian Roller)

Upupidae
108.*Upupa epops* C
(Hoopoe)

Picidae
109. *Jynx torquilla* O + M
(Wryneck)
110.*Dinopium benghalense* R +
(Lesser Goldenbacked Woodpecker)
111. *Picoides mahrattensis* O +
(Yellowfronted Pied Woodpecker)

Alaudidae
112.*Eremopterix grisea* C +
(Ashycrowned Finch Lark)
113. *Eremopterix nigriceps* C +
(Blackcrowned Finch Lark)
114.*Ammomanes phoenicurus* R
(Rufoustailed Finch Lark)
115.*Alaemon alaudipes* R
(Large Desert Lark)
116.*Melanocorypha bimaculata*
(Eastern Calandra Lark) O
117.*Galerida cristata* C
(Crested Lark)

Hirundinidae
118. *Riparia paludicola* O
(Plain Sand Martin)
119. *Hirundo smithii* O
(Wiretailed Swallow)
120. *Hirundo fluvicola* C +
(Indian Cliff Swallow)

Laniidae
121. *Lanius exubitor* C
(Grey Shrike)
122. *Lanius vittatus* O
(Baybacked Shrike)
123. *Lanius schach* C
(Rufousbacked Shrike)

Oriolidae
124. *Oriolus oriolus* O +
(Golden Oriole)

Dicruridae
125. *Dicrurus adsimilis* C +
(Black Drongo)

Sturnidae
126. *Sturnus pagodarum* O +
(Brahminy Myna)
127. *Sturnus roseus* C M
(Rosy Pastor)
128. *Sturnus vulgaris* C M
(Starling)
129. *Sturnus contra* C
(Pied Myna)
130. *Acridotheres tristis* C
(Common Myna)
131. *Acridotheres ginginianus* O
(Bank Myna)

Corvidae
132.*Corvus splendens* A
(House Crow)
133.*Corvus corax* C
(Raven)

Pycnonotidae
134. *Pycnonotus leucogenys* A
(Whitecheeked Bulbul)
135. *Pycnonotus cafer* C +
(Redvented Bulbul)

Muscicapidae (Timalinae)
136. *Turdoides caudatus* A
(Common Babbler)

137. *Turdoides malcolmi* (Large Grey Babbler)	C +
138. *Turdoides striatus* (Jungle Babbler)	R +

Muscicapinae

139. *Muscicapa parva* (Redbreasted Flycatcher)	R +
140. *Rhipidura aureola* (Whitebrowed Fantail Flycatcher)	O +
141. *Terpsiphone paradisi* (Paradise Flycatcher)	R +

Sylviinae

142. *Acrocephalus stentoreus* (Indian Great Reed Warbler)	C +
143. *Hippolais caligata* (Booted Warbler)	O
144. *Sylvia curruca* (Lesser Whitethroat)	C
145. *Sylvia nana* (Desert Warbler)	O

Turdinae

146. *Erythropygia galactotes* (Rufous Chat)	O
147. *Erithacus svecicus* (Bluethroat)	O +
148. *Copsychus saularis* (Magpie Robin)	R +
149. *Phoenicurus ochruros* (Black Redstart)	O
150. *Cercomela fusca* (Brown Rock Chat)	C
151. *Saxicola torquata* (Collared Bush Chat)	O
152. *Saxicola caprata* (Pied Bush Chat)	O
153. *Oenanthe isabellina* (Isabelline Chat)	O
154. *Oenanthe xanthoprymna* (Redtailed Chat)	R
155. *Oenanthe deserti* (Desert Wheatear)	O
156. *Oenanthe picata* (Pied Chat)	C
157. *Saxicoloides fulicata* (Indian Robin)	R +

Motacillidae

158. *Motacilla flava* (Yellow Wagtail)	O + M
159. *Motacilla cinerea* (Grey Wagtail)	O + M
160. *Motacilla alba* (White Wagtail)	C + M
161. *Motacilla maderaspatensis* (Large Pied Wagtail)	O +

Nectariniidae

162. *Nectarinia asiatica* (Purple Sunbird)	C +

Ploceidae

163. *Passer domesticus* (House Sparrow)	A +
164. *Passer hispaniolensis* (Spanish Sparrow)	O M
165. *Petronia xanthocollis* (Yellowthroated Sparrow)	C +
166. *Ploceus manyar* (Streaked Weaver Bird)	O +
167. *Lonchura malabarica* (Whitethroated Munia)	C +
168. (Blackheaded Munia)	R +

Emberizidae

169. *Emberiza melanocephala* (Blackheaded Bunting)	R M
170. *Emberiza bruniceps* (Redheaded Bunting)	R M

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*Note for Sightings etc.

C = Common

R = Rare

+ = the number is likely to increase,

A = Abundant

O = Occasional

M = Migratory

- = the number is likely to decrease

SUMMARY

The article describes the plant species and 170 bird species of scientific interest in studies of biodiversity changes from Indira Gandhi Nahar Project Stage-II, Rajasthan.

इन्दिरा गाँधी नहर परियोजना प्रावस्था II- क्षेत्र के पादपों और पक्षियों की पड़ताल-सूची

आर० जी० सोनी

सारांश

इस अभिपत्र में इन्दिरा गाँधी नहर परियोजना प्रावस्था II राजस्थान की जैवविविधता में हुए परिवर्तन के अध्ययन में वैज्ञानिक रुचि की पादप जातियों और 170 पक्षी जातियों का वर्णन दिया गया है ।

LET THE KING REST IN PEACE : HUMAN IMPACT (TEASING BEHAVIOUR) AT ASIATIC LION EXHIBIT IN MYSORE ZOO

R. RAJU* AND B. VENUGOPAL**

Introduction

Visitors to a Zoo are generally not aware of their conduct in the zoos. Quite often, the Zoo managers come across incidents wherein excited visitors hurt caged animals by teasing and provoking. The teasers are not bothering about the trauma - physical, psychological and physiological - that they cause to helpless animals. Generally, Zoo animals become immune to teasing by visitors. But, sometimes, the animals may react violently causing death of human beings as in Safaries and Zoos. A recent example of this was observed in Bannerghatta National Park where a child was killed by a tiger.

Studies have been initiated in the Chamarajendra Zoological Gardens, Mysore, to understand teasing behaviour. The objective is to get feedback which can act as management tool on the part of the Zoo authorities to improve the conditions for both the Zoo animals and visitors. Studies at the Lion-tailed Macaque (LTM) was over (Venugopal and Sha, 1993), and studies on many more exhibits are under way. The present study involves observation on teasing at the Asiatic Lion exhibit in the Mysore Zoo.

Background

The exhibit : The Zoo exhibit animal for the purpose of the present paper, consists of a pair of Asiatic Lions. The male is 4 1/2 years old and the female 4 years old. The pair was brought to Mysore Zoo in 1989 from Sakkarbaug Zoo, Junagadh.

The visitors : The visitor male or female may be a child (12 years or less), teenager (13-19 years), youth (20-25 years), adult (26-50 years) or old (above 50 years).

Methodology

The method used in this study is based on the Venugopal model and was described by Venugopal and Sha (1993). This involved unobtrusive direct observation of behaviour of visitors based on five loci of attention, i.e., setting, exhibit, members of other social-group (inter-group), members of own group (intra-group) and self. For this study, only teasing behaviour was taken into consideration. The details of teasing behaviour are given in Table 1. Observations were recorded on a data sheet and included details of visitors such as age, sex and type of exhibit. Miscellaneous observations were noted in remarks column. Absence of visitors at the time of observation was also noted.

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Table 1

Teasing behaviour at the Asiatic Lion exhibit

1. Throwing stone/pebble/stick
2. Throwing or giving items of food i.e., Feeding
3. Making sounds with hand i.e., clapping/snapping
4. Making sounds with mouth i.e., whistling/shouting
5. Making faces of mimicking
6. Using hands as if hitting, throwing or waving
7. Spitting
8. Pricking with stick.

Visitors coming to Asiatic Lion exhibit (cage or enclosure) were selected at random. One observation was made at every minute and at a stretch for a minimum of one hour. A total of 1320 observations spanning 22 hours were done, out of which 900 were done at the cage exhibit and 420 at the enclosure exhibit.

Result

Cage exhibit : Out of 900 observations, visitors were present at 629 observations. About 16% (i.e. 98 observations) of the visitors were found to be teasing. Males were found to be more teasing (58%) than females. About 15% of teasers were children, 17%, were teenagers, 32% youth and 35% adults. The old people constituted only one percentage of the teasers. The relationship of teasing with respect to sex and age-group is given in Table 2.

Enclosure exhibit : About 55% of the total observations of 420 at the open enclosure exhibit had at least one visitor. Only a very low number of visitors observed (5%) were teasers. A substantial number of teasers (75%) were males, and only a quarter (25%)

Table 2

Relation of sex and age-group of teasers at the Asiatic Lion Exhibit : Cage

	Age-group						
Sex	Child	Teenage	Youth	Adult	Old	Total	%
Male	9	9	18	20	1	57	58
Female	6	8	13	14	0	41	42
Total	15	17	31	34	1	98	
Percentage	15	17	32	35	1		100

Table 3

Relationship of sex and age - group of teasers at the Asiatic Lion Exhibit : Enclosure

	Age-group						
Sex	Child	Teenage	Youth	Adult	Old	Total	%
Male	0	0	6	3	0	9	75
Female	0	0	1	2	0	3	25
Total	0	0	7	5	0	12	
Percentage	0	0	58	42	0		100

were females. In the present study the different age-groups such as children, teenagers and old were not found to be teasers. About 58% of teasers were youth and 42% adults. Table 3 gives details of sex and age-group of teasers at the enclosure exhibits.

The frequency occurrence of percentage-teasing at the two types of exhibits - cage and enclosure - is given in Table 4.

Table 4

Percentage-teasing and exhibit-type for Zoo visitors at the Lion Exhibit

	Exhibit Type		
Frequency	Cage	Enclosure	Total
Observations	900	420	1320
Visitors	629	229	858
Teasing	98	12	110
Percentage-teasing	16	5	

Discussion

There is no general agreement about the frequency of teasing at the Lion exhibits. Teasing frequencies varied with the type of exhibits (16% at the cage and 5% at the enclosure) and it averaged at 11%. The teasing frequencies at the Lion exhibits at Coimbatore and Madras were 8.4% and 6.8% respectively (Kumaragurubaran, 1992). These observations were less than that found at the LTM exhibit in the Mysore Zoo (Venugopal and Sha, 1993). The large expanse of the enclosure exhibit may be the reason for low teasing frequency observed at Lion-exhibit.

Males were found to be disturbing the Lion more often than females in both types of exhibits. This is in general agreement with other studies on teasing (Kumaragurbaran, 1992; Venugopal and Sha, 1993).

The relationship between frequency of teasing and the age-group of the teaser observed in the study on teasing at Lion-tailed Macaque exhibit (Venugopal and Sha, 1993) i.e., inverse relationship, agrees with observation of teasing at the cage exhibit in this study. However, the data at the enclosure exhibit is not sufficient to prove anything in this regard.

The study also supports observations that even though children are the primary motivators for Zoo visits, they may not be the culprits for teasing (Kumaragurubaran, 1992; Venugopal and Sha, 1993). The children constituted only about 15% of the total teasers at the cage exhibits. Whereas no children was found to be teasing at the enclosure exhibits.

Acknowledgements

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SUMMARY

Teasing behaviour was observed at the Asiatic Lion exhibit in the Mysore Zoo. An average of 11% of visitors were teasers. A majority of teasers were males. The hypothesis that the frequency of teasing is inversely proportional to the age-group of the visitor, was only partially proved; and more data are needed to verify it. Eventhough children may be the primary motivators for Zoo visits, they may not be culprits for teasing.

राजा को शांन्ति से रहने दो - मैसूर प्राण्यालय के एशियाई सिंह प्रदर्श पर मानव प्रभाव [छेड़छाड़ करने का व्यवहार]

आर० राजू व बी० वेणुगोपाल

सारांश

मैसूर प्राण्यालय के ऐशियाई सिंह प्रदर्श से छेड़छाड़ किए जाने का व्यवहार देखा गया। औसतन 11% परिदर्शक छेड़छाड़ करने वाले थे। अधिकांश छेड़छाड़ कर्ता पुरुष थे। यह प्रस्थापना कि छेड़ने वालों का समानुपात परिदर्शकों के आयुवर्ग के साथ उलटा रहता है अंशतः ही सिद्ध हुई और इसका सत्यापन करने के लिए और आंकड़े चाहिएं। भले ही बच्चे प्राण्यालय में दर्शकों के आने का मुख्य कारण हों, छेड़छाड़ करने के गुनहगार वे नहीं होते।

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STUDY OF THE VEGETATION AND FLORA OF RAJIV GANDHI WILDLIFE SANCTUARY, ASSAM

SURENDRA MOHAN NATH* AND S. CHOWDHURY**

Introduction

Rajiv Gandhi Wildlife Sanctuary renamed from well known Orang Wildlife Sanctuary of Darrang district of Assam a well protected sanctuary from ravaging activities since 1st November 1972, when it came under Wildlife Regulation Act (1972) for protection and conservation. It is one of the finest sanctuaries of Assam, blessed by nature's bounty of natural resources, a repository of the World famous one horned Rhino (*Rhinoceros unicornis*), Tiger (*Panthera tigris*), Leopard (*P. pardus*), Asiatic elephant (*Elephas maximus*), Wildboar (*Sus scrofa-cristata*), Swamp deer (*Cervis duavauceli duavauceli*) and reptiles. This sanctuary is also an abode of a number of birds including Pelicans (*Pelecanus philippensis philippensis*) and Bengal Floricans (*Eupodotis bengalensis*) and a habitat of migratory birds. The vegetation and its floristic elements provide flood, fodder, shelter and camouflage of wild animals.

But is seems, it has not been given due attention by early plant collectors, although the State had the distinction of exploration work by a number of distinguished explorers since 1820. Only the casual references of plants have been made by Kanjilal *et al.* (1934-1940) and Bor (1940), Hooker (1872-1897) and in 1970's by Rao and Verma. The reorganisation of B.S.I. with establishment of Regional headquaters at Shillong in 1956, made valuable collection upto the period of 31st May, 1966 and published (Rao-Verma, 1972-1982) their account in series with or without a reference of representation of the plant of the sanctuary. However, certain aspect of the work of this type has been presented by Jain and Hajra (1975) and later Hajra (1978). Sporadic contribution have also been made by Jain and Hajra (1975) on certain floristic elements of protected habitat in Assam as also by Kataki and Bourah (1989). This has necessitated the study of the Rajiv Gandhi Wildlife Sanctuary, Darrang, Assam.

Physiography

The Sanctuary is situated 130 km away from Guwahati a flood plain of the mighty River Brahmaputra on its North Bank and its tributary Dhansiri which flow by the South-western part of the Sanctuary. Only the River Pachnoi - a tributary of Brahmaputra-traversed with its branches through the heart of the Sanctuary. The Sanctuary covers an area of nearly 80 km^2 and lies between 26°30'N - 26° 40'N and 92°15'E-92°30'E and falls well within Darrang District with but a small area of Sonitpur district towards eastern fringe.

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On the basis of soil character it may be possible to demarcate the Sanctuary into three different regions. The southern part of the Sanctuary nearly covering 60% of the area is low lying inundated annualy by flood water of River Brahmaputra is of recent origin with sandy alluvial soil with a number of depressions, large or small, retained water even after receding flood water and formed Beels and marshy swamps - an ideal habitat for Rhinos. Some what older alluvial soil is found on the central part forming highland in between the two banks of the rivers Dhansiri and Pachnoi where most of the animals are found to take shelter during the flood extending from June to October. Whereas the Northern part is of older origin composed mostly of alluvial soil with as many as 26 man-made ponds of different geometrical shapes of early historical origin, the banks of which are covered with black porous soil enriched with humus. The altitudes ranges between 30 m to 80 m ASL.

Climate

A sub-humid tropical area enjoys typical monsoon climate with average rainfall being 2500 mm with heavy precipitation during the months of June-September. The maximum and minimum temperatures are with annual average 41°C and 7°C respectively. The relative humidity has been found to be 50%-60% in southern part and central parts whereas it is nearly 90% in northern parts and more particularly in Old Orang Region.

Observations

Since August, 1991, several collection trips have been undertaken and yielded as many as 669 field numbers to the present and revealed interesting findings not only its vegetation and composition of floristic elements but also food habit of Rhinos and Wild-boars as well. The plant species that have so far been identified, representing 95 families comprising 322 genera and 450 species of Angiosperms; 10 families with 12 species of Ferns and Fern-allies and a single Gymnosperm. The family Poaceae with 45 species is found to be the largest (Table 1) in an area of *c* 80 km² where as Kataki and Bourah (1989) reported only 53 species from Manas Biosphere Reserve having core area of *c* 391 km². Besides Grasses, a number ground orchids have been collected and discovered 2 new records of species from North-East viz., *Pecteilis triflora* and a peculiar pungent smelling *Habeneria graveolens*. Based on representation of number of species found in a family, the largest 11 families are shown in Table 1.

Table 1

Family	Number of Genera	Number of species
Poaceae	37	45
Papilionaceae	20	36
Asteraceae	28	33
Cyperaceae	6	26
Euphorbiaceae	13	17
Scrophulariaceae	10	14
Verbenaceae	10	12
Acanthaceae	8	12
Polygonaceae	2	12
Lamiaceae	10	10
Orchidaceae	8	10

The area broadly encompasses the vegetation of a Deciduous type in Natural forested land and mixed Deciduous type in man-made forest. the Natural forests comprise of the common tree species viz. *Sterculia villosa, Melia azadirachta, Toona ciliata, Dysoxylum binectariferum, Kydia calycina, Litsea monopetala, Albizia procera, A. lebbek, Callicarpa arborea, Biscofia* *javanica, Trema orinentalis, Ficus neriifolia* var. *nemoralis* and in some places with a pure stand of *Semicarpus anacardium, Bridelia retusa, Oroxylum indicum* and *Mallotus philippensis* etc.; shruby species along the edges of the forest and are commonly met with species like *Clerodendrum serratum, Abroma angusta, Micromelum minuta, Strebus asper, Litsea salicifolia, Leea asiatica, Indigofera hamiltonii, Sesbania aculeata, Solanum torvum, Lantana camera* var. *aculeata, Phyllanthus reticulatus* etc. whereas the ground cover in and around the forests are with the species of herbaceous in nature with both annual and perennial. The species are *Ageratum conyzoides, Bidens pilosa, Pouzolzia zeylanica, Polygala glomerata, P. chinese* var. *linifolium, Scoparia dulcis, Grewia assamica, Cassia tora, C. sophera, Youngia japonica, Rauvolfia serpentina* and in abundance of Fern *Cyclosorus parasticus* is found to be quite common growing along with bulbous, rhizomatous herbs covering the forest floor, most common are *Curcuma zedoaria, C. montana, Costus speciosus, Alpinia nigra, Curculigo orchioides, Zingiber zerumbet* and *Hedychium* spp. The common ground orchids spp. occurring in the Sanctuary are *Geodorum densiflorum, Eulophia* spp., *Habenaria stenopetala* and *Nervillia juliana* etc. Along with these the parasitic species like *Helixanthera ligustrina* (Partial stem parasites on *Litsea monopetala*) and *Aeginetia* spp. (Total parasites on grass roots are more common in the Sanctuary.

Bordering natural forested land and man-made forest and on highland consisting of Savannah Ecosystem with the association of *Imperata cylindrica, I. cylindrica* var. *koenigii, Erianthus ravannae, Arundinella nepalensis, A. decempedalis* interspersed with *Alpinia nigra, Hedychium* spp., gregarious growth of *Leea asiatica* and scarcely distributed tree species of *Acacia catechu, Bombax ceiba, Anthocephalus chinensis* and *Zizyphus mauritiana* whereas low-lying area annually inundated by River Brahmaputra and its tributaries Dhansiri and over flowing of River Pachnoi, there is pure Grassland with association of *Themeda villosa, Arundo donax, Phragmatis karka, Erianthus ravannae, Apluda mutica* etc. attaining 3-5 m in height serving as hiding place and camouflage to wild animals. Along the edges of Grassland in marshy depression and perennial water reservoir, Beels where in abundance of low grasses and sedges. Among the grasses, the common palatable ones for herbivores are *Seteria pumila, Saccolepis interrupta, S. indica, Vetiveria zizanoides, Desmostachya bipinnata, Brachiaria ramosa, Agrotis zenkiri, Apocopsis paleacea, Hemarthria compressa, H. protensa* etc. Sedges are *Cyperus haspan, C. hyalinus, C. compressus, Scirpus juncoides, S. grossus, Carex phacota* etc. Along with these grasses and sedges, one will find plenty of *Polygonum* species viz. *Polygonum strigosum, P. flexuosum, P. orientale,* etc. Others which still retained water are with *Nelumbo nucifera* where Rhinos love of wallow.

At the riparian belt species of *Themeda-Erianthus-Imperata* association mixed sparsely with *Tamarix dioica, Crotalaria pellida* and a few tree species of *Acacia catechu, Zigyphyus mauritiana* etc. and char areas of mainly *Imperata cylindrica, I. cylindrica* var. *koenigii* with *Arundo donax* just started settling and *Typha angustifolia* in small patches are found along the edges.

The prominent tree species in the man-made forest are with species like viz., *Michelia champaca, Dalbergia sissoo, Lagerstroemia reginae, Chukrasia tabularis, Gmelina arborea, Terminelia bellirica, T. arjuna, Phoebe goalparensis, Mangifera indica, Delonix regia, Dillenia indica* etc.

In the oldest area, for example "Azar Bagan" based on *Lagerstroemia reginae*, locally called `Azar' sheltering epiphytic species like viz., *Papilionanthe teres*, *Dendrobium aphyllum* along with Fern species of *Microsorium punctatum* and *Drynaria quercifolia*; "Sat simul" with *Bombax ceiba*. The investigation reveals magnificient Forest-Ecosystem with a variety of plant resources. Besides timber yielding plant, there are a number of medicinal plants growing luxuriantly in the forested land. Mention may be made of *Rauvolfia serpentina*, *Curcuma zedoaria*, *Costus speciosus*, *Holarrhena antidysenterica* etc. are found to be in abundance, whereas *Semicarpus anacardium* forming a pure stand, the fruits of which are utillized in preparation of indeliable ink. On the other hand, along with grasses interesting finding of *Equisetum diffusum* and *E. ramosissimum* var. *debile* as these fern allies are very much palatable to *Rhinoceros unicornis* whereas Wildboar's love to devour bulbs, rhizomes and even bulbs of ground orchids viz. *Geodorum densiflorum* and species of *Eulophia, Habenaria* only when plants are fully matured enriched with storage products in their underground organs. A few patches of *Cynodon dactylon* a platable grass for deer in savannah grassland and also patches of *Apocopsis paleacea* and *Hemarthria compressa, H. protensa* in wetland as well as in marshy depression observed to be more favourite ones for *Rhinoceros unicornis* as well. That shows the vegetation and its component of Floristic elements have great impact on the Growth and Development of wildlife and their interrelationship.

Although a number of grass species are found in the Sanctuary that is not sufficient for the whole year for better growth and development of herbivores. Studies made during the field trips have been worthwhile and accordingly certain measures have been forwarded.

1. As the Sanctuary is locted in a flood prone area nearly 50% or so, the Southern part remained under water atleast from July to September annually. As such wild animals have to take shelter on Highland in the central part of the Sanctuary. At the time, the fodder grasses attain a height of 3-5m that serves only the purpose of hiding but could not be utilised as fodder. The Herbivores love only sprouting tender leaves and for that they have to move out in search of food.

2. Lack of sufficient food and fodder during winter months as there is cessation of growth of fodder grasses coupled with annual burning resulted in the migration of Rhinos, Deers and Elephants to nearby settlements causing great harm to local inhabitants where they have to spend sleepless nights for protection of their crops.

Measures should be adopted so as to control the migration of Herbivores for search of food and fodder. That may be possible only when cutting and clipping of grasses are to be done at regular intervals just above the ground level retaining the first node and when that are found already more than a meter in height during the period from May to September and that too particularly in central part of the Sanctuary comprising 20% of high land. That may serve 2 purposes : (1) cut out portion may be utilised for thatching or in Paper Industry, (2) it allows the offshoots/innovations for vigorous growth from sobules which will be very much palatable for Herbivores.

Although burning is useful for luxuriant growth of grasses but it destroys totally the herbaceous plants leaving only the bulbous, rhizomatous which penetrate deep underground. Controlled burning after 2 or 3 years of some places of highland may be tried along with clipping and cutting at places where the soil retains moisture even in winter months.

A few patches of *Cynodon dactylon* - a palatable grass for Deers and found in Savannah Grassland - and absence of fruit trees like *Phyllanthus emblica, Spondias pinnata* and *Elaeocharis floribunda* etc. may cause migration towards the crop land of local inhabitants residing at the out-skirts of the Sanctuary Cultivation of these plants is suggested.

Moreover, abundance of *Leea crispata* with its gregarious growth may take up sufficient nutrients from the soil which result in deterioration of growth of grasses. Eradication of some, if not all, is suggested alongwith eradication of a semi-parasitic plant *Helixanthera ligustrina* which is a specific parasite only on *Litsea monopetala* (*L. polyantha*) a primitive indegenous plant of Assam found in and around Silbori Forest Range causing great damage to host and totally destroying it, is suggested.

Acknowledgements

Grateful thanks are due to Assam Science Technology and Environment Council for Financial Assistance. We also record our warm appreciation to C.C.F. (Wildlife) and the forest staff of Rajiv Gandhi Wildlife Sanctuary and more particularly to Mr. B.N. Talukdar, F.R.O.

SUMMARY

Rajiv Gandhi Wildlife Sanctuary, renamed from well know Orang Wildlife Sanctuary, situated well within Darrang District with but a small area towards eastern fringe in Sonitpur district of Assam, lies between 26°30' - 26°40' N and 92°15' - 92° 30' E covers an area of nearly 80 km^2. A flood plain of River Brahmaputra and its tributary Dhansiri presents a sub-humid tropical area encompassing magnificent man-made forest of indegenous plant species (not less than 50 species) of Assam; natural forested land of deciduous species; savannah; extensive pure grasslands and luxuriant wetlands. An excellent habitat for endangered *Rhinoceros unicornis* and other wild animals. Based on several field trips conducted since August 1991, the authors collected as many as 669 in field numbers to the present, revealed interesting findings not only its vegetation and composition of floristic elements including 45 specifies of grasses, 26 species of sedges and a number of ground orchids with 2 new records of species from North-Eastern Region viz., *Pecteilis triflora* and a peculiar pungent smelling *Habeneria graveolens* but also on the food habit of particularly *Rhinocerous unicornis* and *Sus scorofa-cristata* as well. Besides grasses, most palatable amongst others for Rhios are *Equisetum diffusum* and *E. ramossisimum* sub-sp. *debile* of Fern allies whereas Wildboar even love to devour matured bulbs of ground orchids like species of *Geodorum densiflorum, Eulophia* and *Habeneria* etc. A variety of plant resources and its impact on growth and development of wildlife has also been high-lighted in the paper.

राजीव गाँधी वन्यप्राणी अभयारण्य, असम की वनस्पतियों और पेड़-पौधों का अध्ययन

सुरेन्द्र मोहन नाथ व एस० चौधरी

सारांश

प्रसिद्ध ओरेंज वन्यप्राणी अभयारण्य का नाम बदला हुआ राजीव गाँधी वन्यप्राणी अभयारण्य, असम, जो असम के शोनितपुर जिले के पूर्वी तरफ की झालर के छोटे से क्षेत्र को छोड़कर लगभग सारे का सारा दारंग जिले में स्थित है, $26^{0} 30'$ -$26^{0} 40'$ उत्तर अक्षंश और $92^{0} 15'$-$92^{0} 30'$ पूर्व देशान्तर के बीच पड़ता है, 80 वर्ग किलोमीटर क्षेत्र में फैल हुआ है । ब्रह्मपुत्र और उसकी सहायक घनश्री नदी की पूरे जल से वन मैदान उपआर्द्र उष्ण क्षेत्र है जिसमें असम की देशी पादप जातियों (50 से अन्यून जातियाँ) के शानदार मानव-निर्मित वन, पर्णपाती जातियों के प्राकृतिक वन क्षेत्र, घास प्रदेश, विस्तृत घास क्षेत्र और भरे-पूरे जलीय क्षेत्र फैले हुए हैं । विलुप्ति खतरे में पड़े *एकश्रृंगी* गैंडे (*राइनोसेरस युनिकार्निस*) और अन्य वन्य प्राणियों के लिए यह अत्युत्त्म प्राकृतावास है । अगस्त 1991 के बाद इस क्षेत्र में की गई कई यात्राओं के आधार पर अबतक 669 जितनी अधिक संख्या में एकत्र किए गए पर्यवेक्षणों से न केवल वनस्पतियों और पादप मात्रिकीय अंशों के बारे में रोचक बातों का पता लगा है, जिनमें 45 घासों की जातिया 26 वलीकों (सेज) की और कई प्रकार के पीनशिफ सम्मिलित हैं जिनमें से दो जातियों का अर्थात् *पेक्टेइलिस ट्राइफ्लोरा* और एक तीखी गंध वाला *हैबेनेरिया ग्रेवियोलेंस* उत्तर पूर्वी क्षेत्र से मिली जातियों के नवोल्लेख हैं, बल्कि विशेषकर के *राइनोसेरस युनिकार्निस* और *सुस स्कोरोफो-क्रिस्टेटा* की भोजन आदतों पर भी नई जनकारी मिली है । घासों के अलावा गैंडों के अन्य खाद्यों के साथ सबसे अधिक सुस्वादु भोजन पर्णांगों के साथ पाई जाने वाली *इक्विसेटुम डिफ्युजम* और इ० *रेमोस्सीसीमम* उपजाति डेबिले हैं जबकि जंगली सुअर *गिओडोरम डेंसिफ्लोरम*, *युलोफिया* और *हैबेनेरिया* आदि जैसे भूमि पीनशिफों के प्रौढ़ आकन्दों तक को भी खा डालना पसन्द करते हैं । पादप संसाधनों की नानारूपता तथा वन्यप्राणियों की वृद्धि और विकास पर इनके प्रभाव को भी इस अभिपत्र में प्रकाशित किया गया है ।

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FODDER GRASSES OF INDIAN SANCTUARIES I - IDENTIFICATION OF GRASSES, CONSUMED BY HERBIVORES, IN THE MAHANANDA AND OTHER WILDLIFE SANCTUARIES OF NORTH BENGAL.

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Introduction

The grass plantation programme has been undertaken by the West Bengal Forest Department, to enrich the forests with more grass lands to keep the foraging herds of wild elephants and other wild herbivores at bay, within the areas of sanctuaries.

It becomes very difficult to implement the plantation programme without the prescribed formulation which should contain the informations as the selection of grass species depending on the type of soil, method of plantation, nature of plant parts to be used for propagation and weed control.

This grass identification programme has been undertaken in North Bengal Sanctuaries to compile a comprehensive account of certain grass species which are prevailing in the forests and grasslands of Indian sanctuaries and are preferred and consumed by the wild herbivores.

Materials and Methods

The grass species were collected on the basis of reports from reliable sources. The herbarium specimens, in duplicate, were prepared on the spot, and the reference number was given to the specimens, indicating the specific site of collection and number of collections. The fresh and dried specimens were examined in the laboratory at the Sukna Range office.

Identification : The most invaluable species have been identified with the help of B.S.I., Howrah and works contributed by Bor (1960), Prain (1903), Hooker (1897), Karthikayen *et al.* (1989), Mukherjee (1984), Pant (1986) and Roy (1984). The grass species belong to the family Gramineae or Poaceae which has the very distinctive features and can easily be isolated from other groups of plants.

Out of a large number of specimens collected and identified so far, only a small number of plants, which are highly preferred and consumed by wild herbivores, have been listed here.

Agrostis brachiata Munro. (Fig. 5)
Consumed by - Gaur and smaller herbivores.

Anthistiria gigantea Cav., var. *arundinacea* Hack. (Fig. 3)
Consumed by - Elephant, Rhino and Gaur.

Axonopus compressus (Swartz.) Beauv.
Consumed by - All grazing herbivores.

Brachiaria ramosa (L.) Stapf.
Consumed by - Smaller herbivores.

Capillipedium assimile (Steud.) A. Camus (Fig. 7)
Consumed by - Gaur, Deer and smaller herbivores.

Centotheca lappacea (L.) Desv.
Consumed by - Deer.

Chrysopogon aciculatus (Retz.) Trin. (Syn. *Andropogon aciculatus* Retz.)
Consumed by - Seedlings are grazed by medium size herbivores.

Cymbopogon pendulens (Nees & Steud.) Wats.
Consumed by - Gaur and Deer.

Digitaria biformis Willd.
Consumed by - Gaur and smaller herbivores.

Digitaria longiflora (Retz.) Pers.
Consumed by - Smaller herbivores.

Digitaria sanguinalis Scop., var. *defilis* Prain.
Consumed by - Gaur and smaller herbivores.

Eragrostis pilosa Beauv.
Consumed by - All grazing small herbivores.

Ischaemum angustifolium Hack.
Consumed by - All smaller herbivores.

Ischaemum aristatum Linn., sub. sp. *imberbe* Hack. (Fig. 2)
Consumed by - Elephant, Gaur, Rhino, etc.

Oryza granulata Nees & Arn. (Fig. 10)
Consumed by - Deers and Sambar.

Panicum flavescens Sw. (Fig. 4)
Consumed by - All the wild herbivores.

Panicum repens Linn.
Consumed by - All smaller herbivores.

Paspalum orbiculare Forst.
Consumed by - Deer.

Rottboelia compressa Linn. f.
Consumed by - Small herbivores.

Rottboelia exaltata Linn. f.
Consumed by - All large herbivores.

Rottboelia protensa Hack.
Consumed by - Smaller herbivores.

Saccharum arundinaceum Retz., var *ciliaris* Prain. (Fig. 1)
Consumed by - All herbivores.

Saccharum bengalense Retz.
Consumed by - Elephant, Rhinoceros, Gaur and Deer.

Saccharum spontaneum Linn. (Fig. 9)
Consumed by - All larger herbivores.

Setaria glauca Beauv.
Consumed by - All smaller herbivores.

Setaria palmifolia (Koen.) Stapf. (Fig. 8)
Consumed by - All herbivores.

Discussion

The grassland is the most important component of any terrestrial ecosystem and the nature of wildlife present in any sanctuary is the manifestation of quality and quantity of grassland vegetation in existence there. These typical alluvial

"Savannah" grasslands of Eastern sub-Himalayas, with mixed type of vegetation, not only are the homelands of many mammalian herbivores, but also provide seed and insects to the avian fauna of this region. In recent years, due to various interwoven factors, these precious forest grasslands have undergone an alarming degree of destruction.

Problems - The restoration or afforestation processes have not been as easy task because of the presence of various obstacles as (1) frenzied urbanisation destroying the forests and forest corridors, (2) decrease in the natural fodder due to invasion of forests by domestic cattle, (3) poaching activities, and (4) the resultant destructive behaviour of pachyderms leading to unpleasant consequences.

Solution - These are no discrete problems. The whole restoration process requires the cohesion of professional expertise and spontaneous involvement of urban societies. Yet, these problems can be minimised, if not fully solved, under the existing situation. For example (1) The cattle farming can be brought under co-operative system to help the cattle grower to acquire cattle feed, (2) To prevent poaching, (3) Research Laboratories, as one in the Sukna Range Office, can be setup at various vantage Range Offices, (4) To motivate the people by providing them with social security, education for their children and medical aid, (5) Forestry can be introduced, as a separate subject, at the undergraduate level, to enhance mass-education.

Formulation - On close examination of growth pattern, flowering, ecological factors and nature of soil supporting the luxuriant growth of these wild fodder grasses, the following guidelines are suggested for plantation of these grasses :

(1) *Site* : It should be an open area (or glade) which can artificially be made by clearing weeds and bushes.

(2) *Season* : Best time is June-August, with RH more than 90% and temperature 30-38°C, for sprouting rhizomes and germinating seeds.

(3) *Soil pH* : The optimum pH Range is 6.8 - 7.4 and the pH maxima is 5.8 - 8.0.

(4) *Soil type and species selection* : (a) For low land, with moist, sandy loam or silt, pH around 7.0, the varieties as - *Anthistiria gigantea, Saccharum arundinaceum, Ischaemum aristatum*, Bhutta ghas, *Rottboelia* sp., *Setaria* sp. can give expected result. (b) For porous, well drained, highlands with clay and sandy loam, having pH around 7.0, the desired result can be obtained by using *Saccharum bengalense, Capillipedium assimile, Ischaemum angustifolium, Saccharum spontaneum, Cymbopogon pendulens, Setaria palmifolia, Agrostis brachiata* etc. (c) For highlands with clay loam having moisture and humus, mixed plantation can also give very good result. The grasses as *Saccharum arundinaceum, Anthistiria gigantea, Panicum flavescence, Ischaemum aristatum,* etc. along with *Alpinia malaccensis* (Fig. 12). *Amarantus spinosus* Linn. and *A. viridis* L. var. *fasciata* etc., can be used for this purpose. (d) For better result, the open grassland plantation can be alternated with patches of tree plantation of *Dillenia pentagyna* (Fig. 15), *Eugenia jambob* and *E. jambolana, Grewia asiatica,* various *Ficus* sp. etc., of which the fruits are consumed by birds and monkeys while

Natural Growth of Larger Grasses.

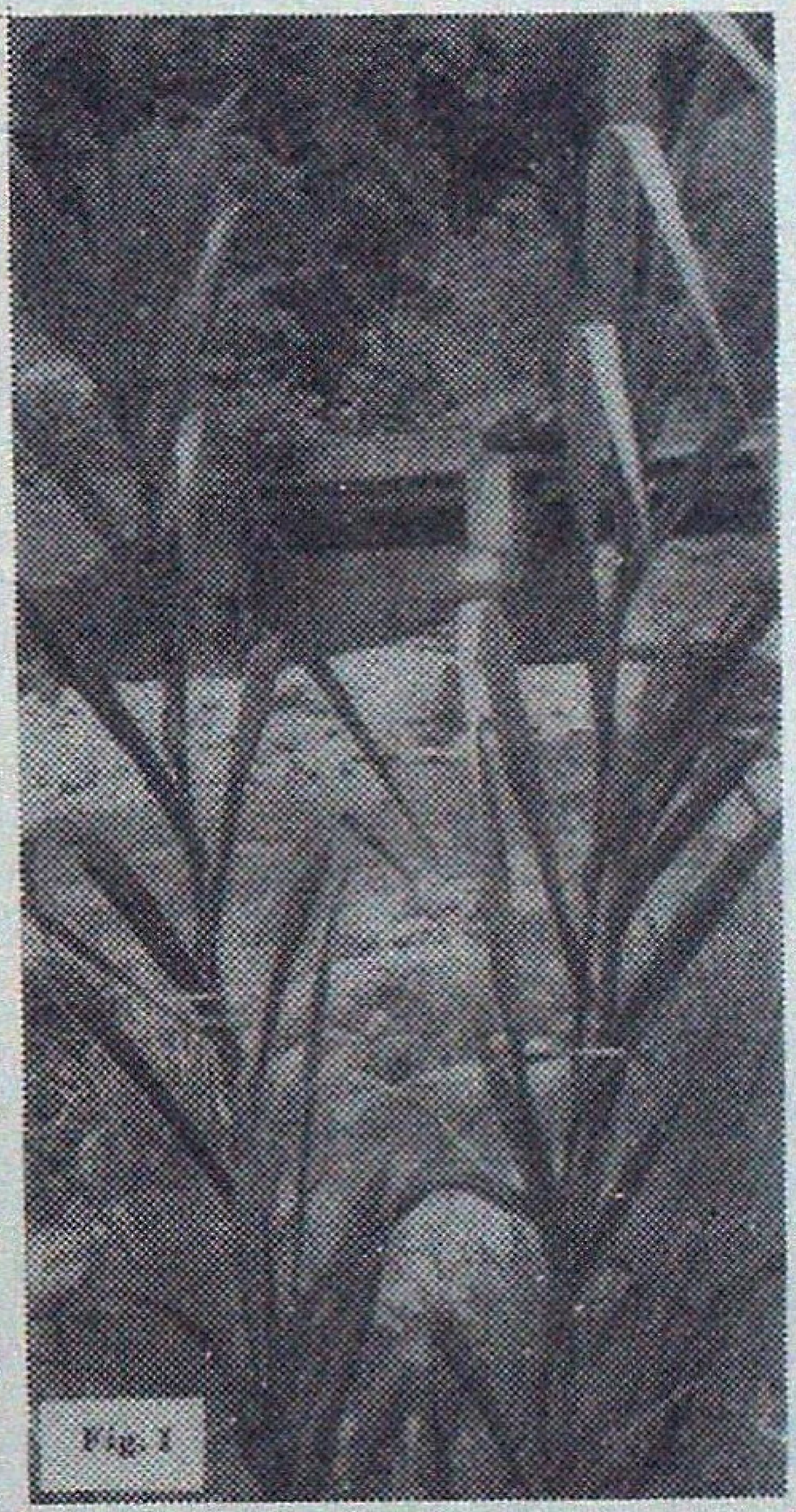


Fig. 1

Fig. 2

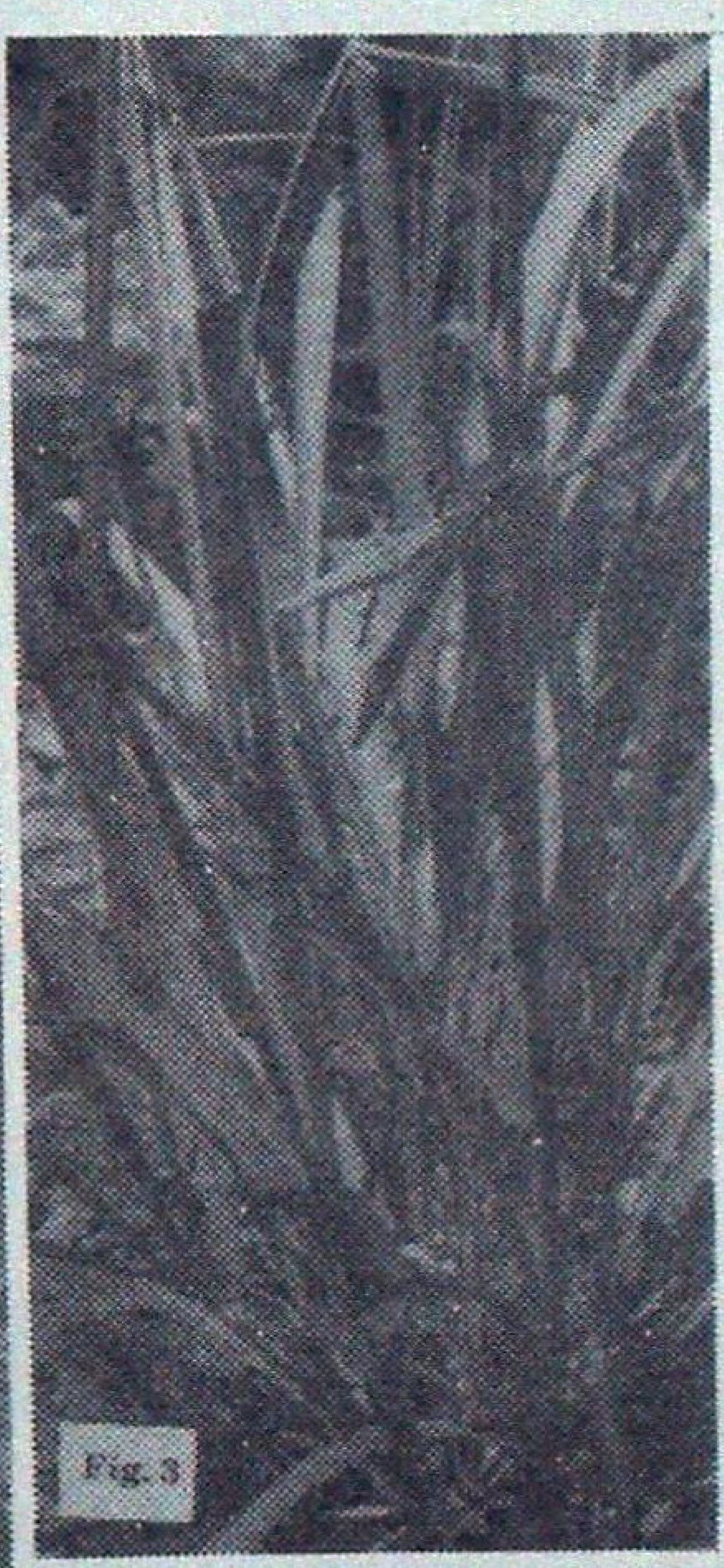


Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

1. *Saccharum arundinaceum;* 2. *Ischaemum aristatum;* 3. *Anthistiria gigantea;* 4. *Panicum flavescence;* 5. *Agrotis brachiata;* 6. *Saccharum bengalense;* 7. *Capillipedium assimile;*

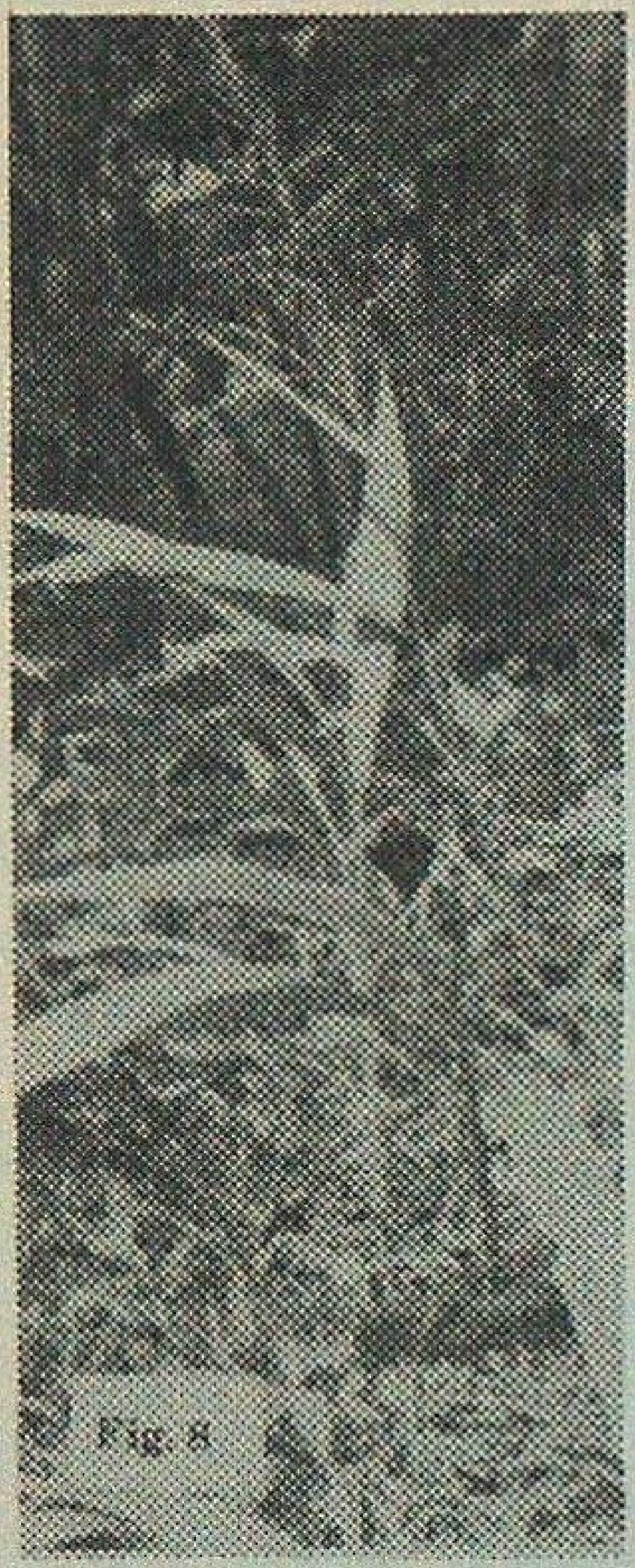
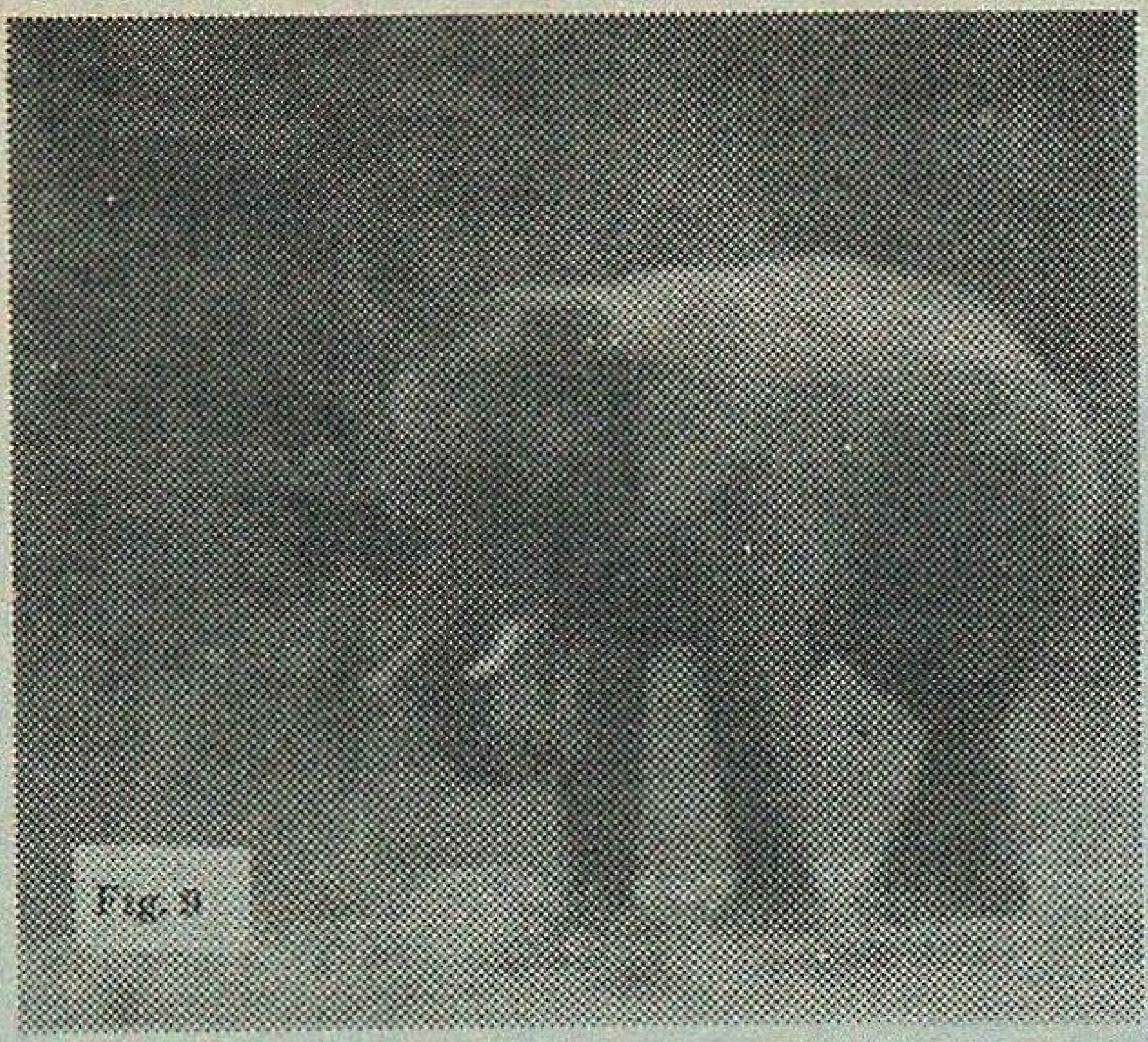


Fig. 8



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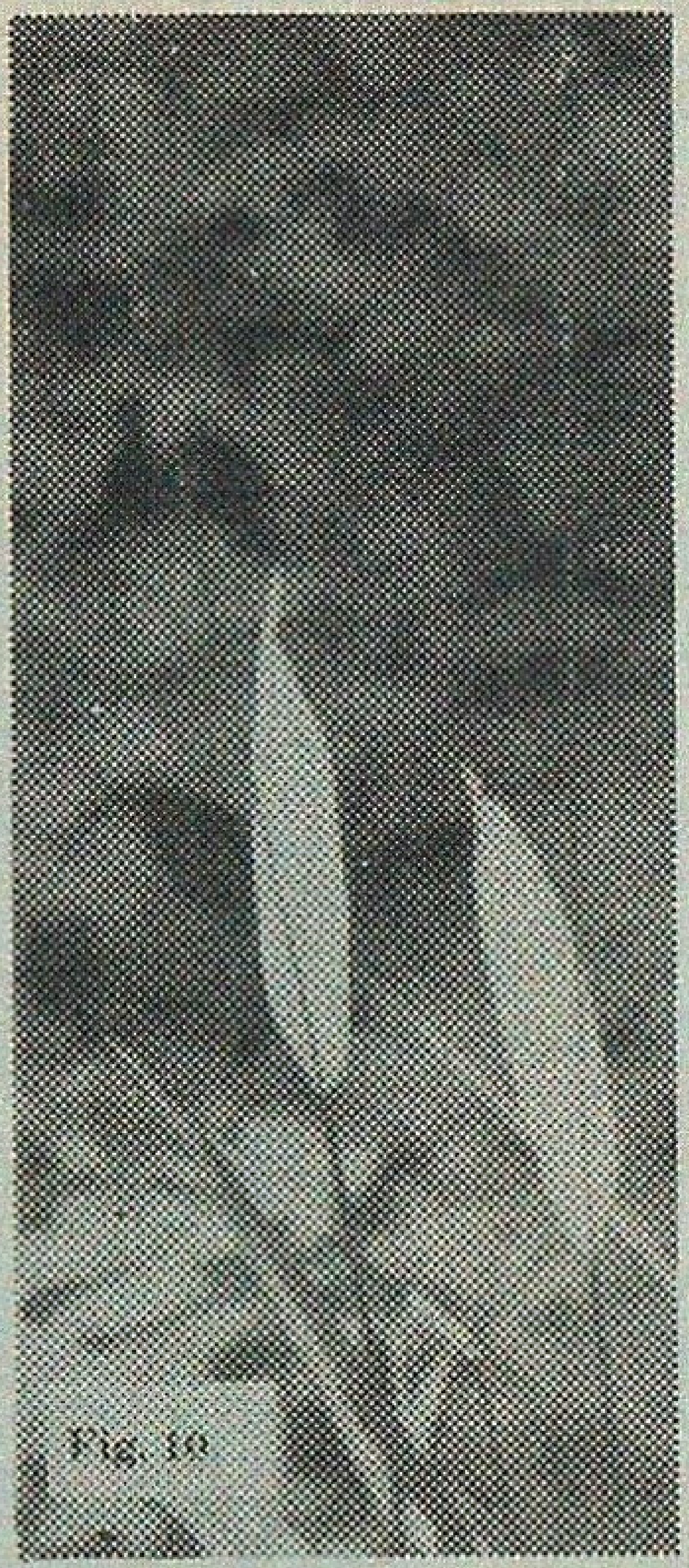

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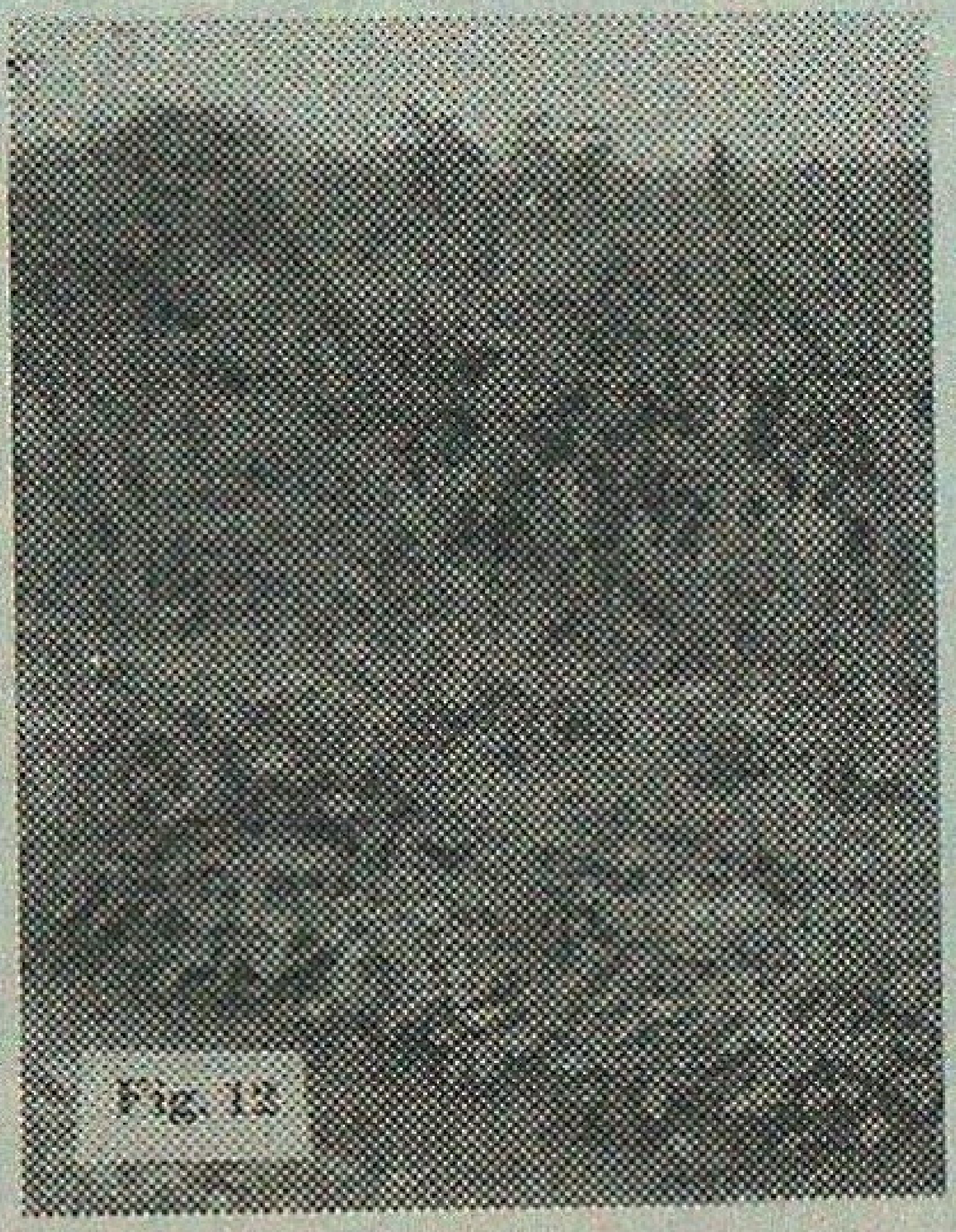

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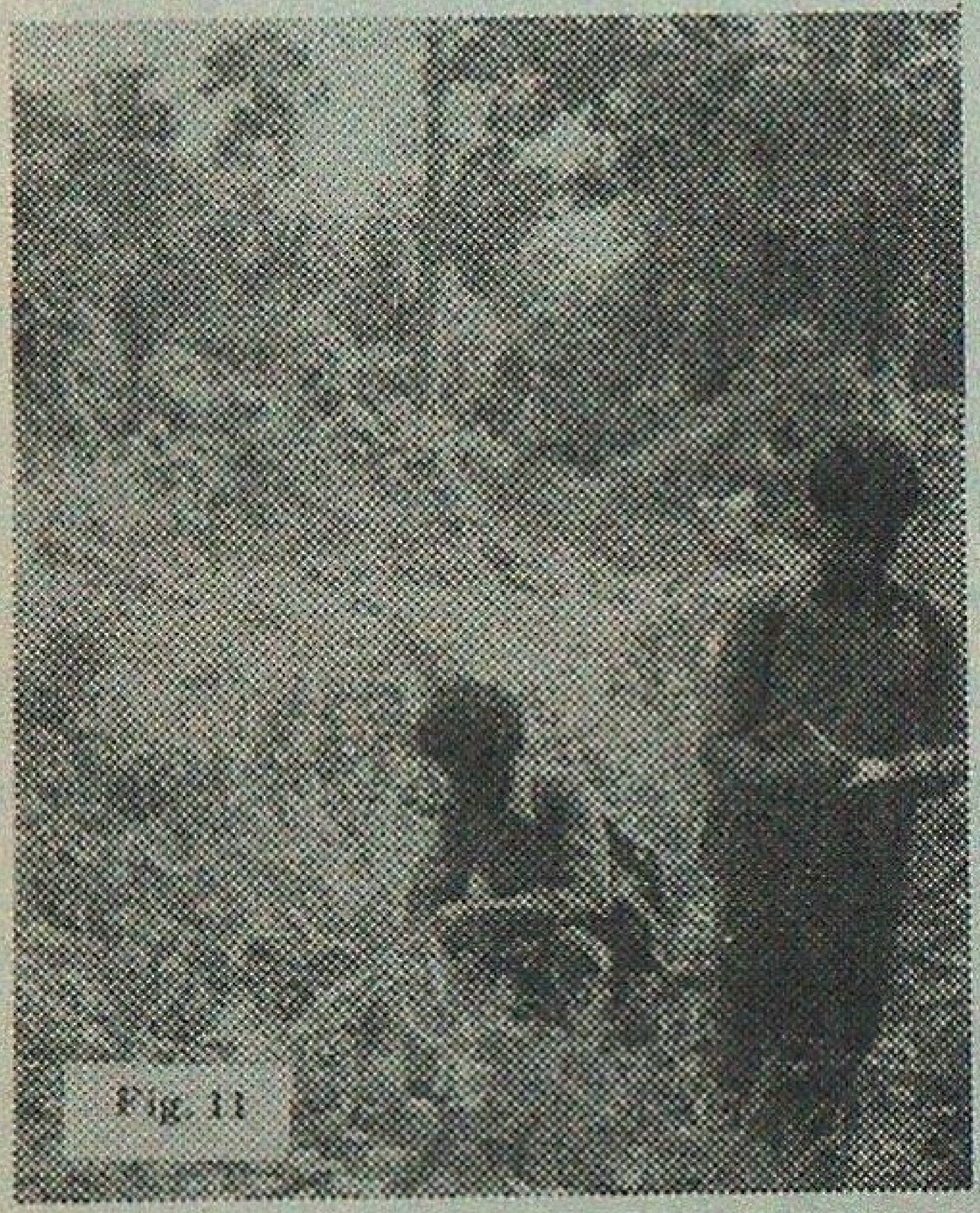

Fig. 11

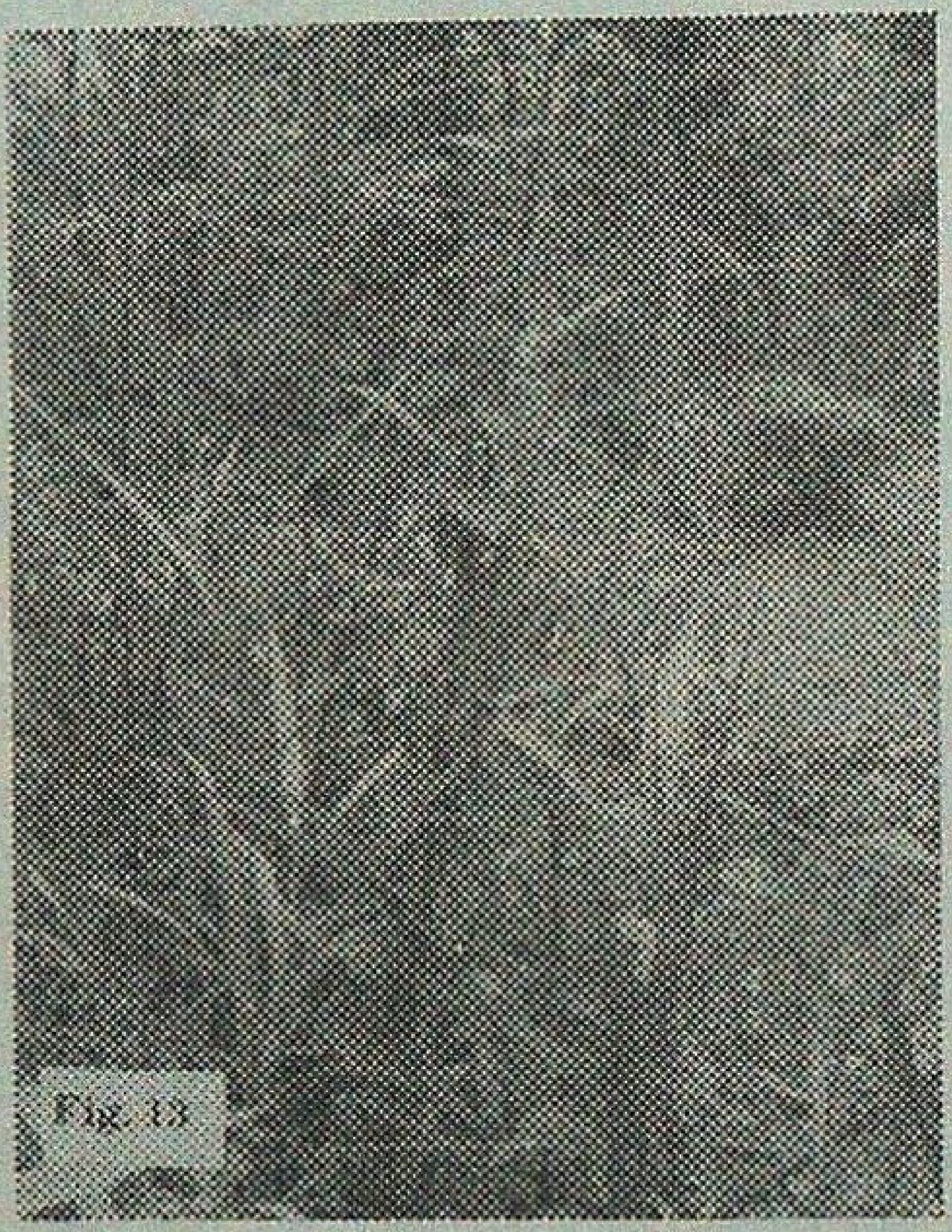

Fig. 13

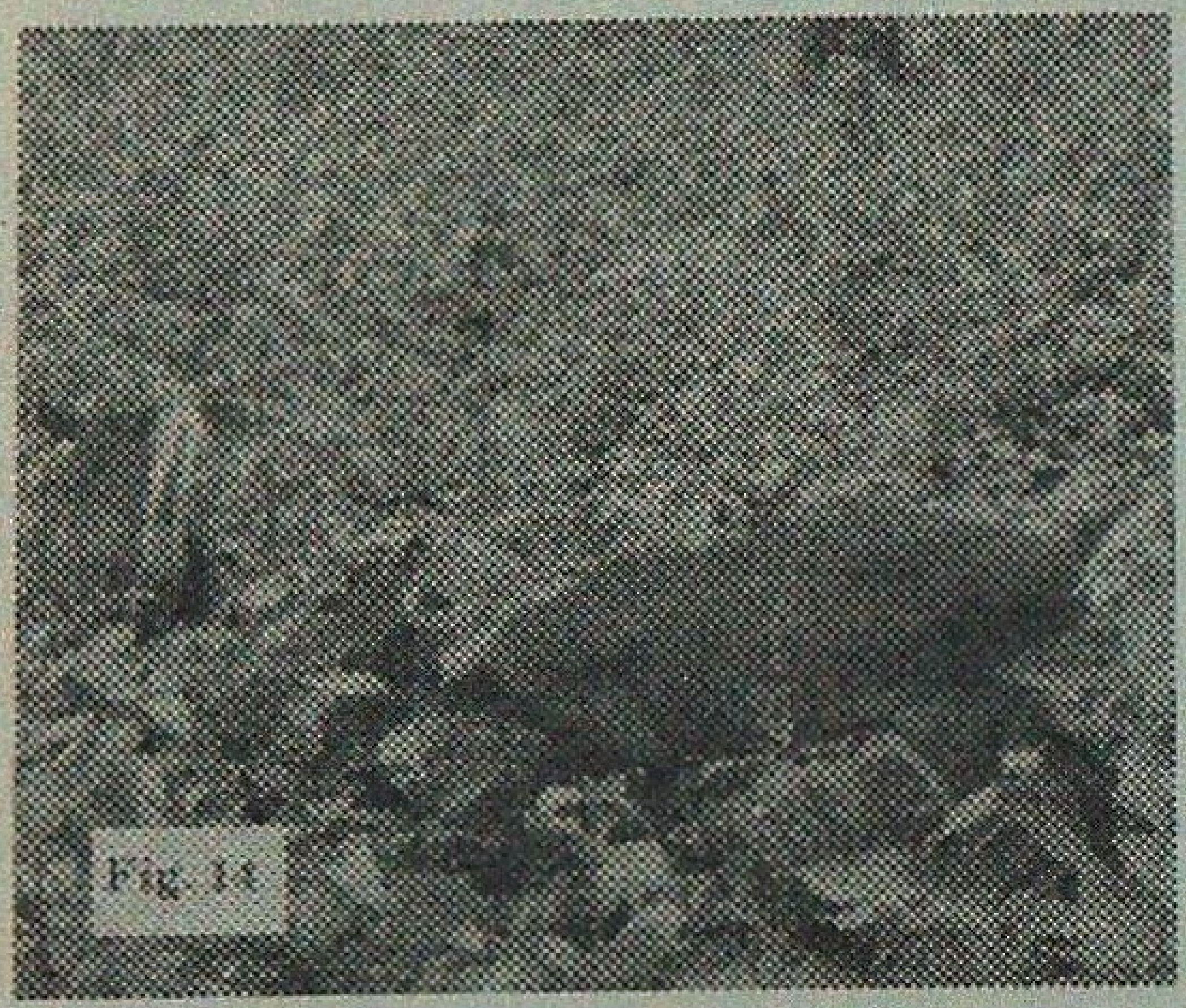

Fig. 14

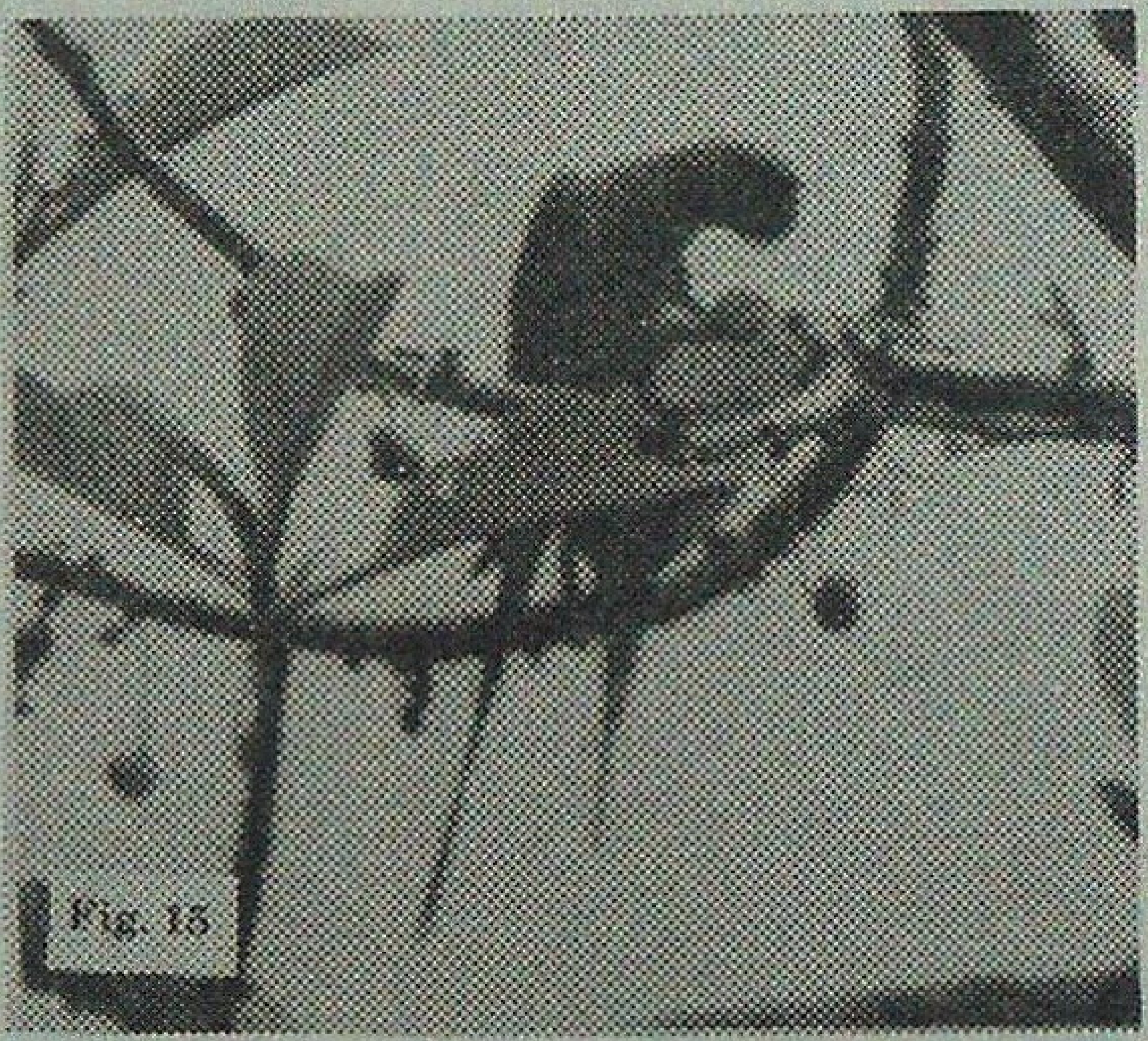

Fig. 15

8. *Setaria palmifolia*; 9. Elephant feeding on *Saccharum spontaneum*; 10. *Oryza granulata*; 11. Invasion of *Cuscuta reflexa* destroying grasses and herbs; 12. Mixed type of vegetation with *Alpinia malaccensis*; 13. *Mikania cordata* creeping over grasses; 14. Growth of *Eupatorium odoratum* has completely eradicated grasses; 15. Birds feeding on Tantari fruits (*Dillenia pentagyna*).

the fallen ones are delicacies of smaller herbivores.

(5) *The Seeds* : For larger varieties, the rhizomatous stock should be used, which are also drought resistant and seeds can also be used where plenty of water is available.

(6) *The Weed and its Control* : A number of dicotyledonous weeds have been identified which are found growing very fast, occupying a vast area at the expense of grasslands. The most common of these weeds are - *Cuscuta reflexa* (Fig. 11), *Vernonia bracteata* Wall., *V. cinerera* Less., *Eupatorium odoratum* (Fig. 14), *Mikania cordata* (Fig. 13), *Mitreola oldenlandioides, Leea crispa* Linn., *Vitis trifolia* Linn., *Sida rhombifolia*, a few patches of *Parthenium* sp. and *Cannabis sativa* etc. which should be eradicated manually. To eradicate dicotyledonous weeds, the chemicals as 2, 4-D (2, 4-dichlorophenoxyacetic acid; @ 0.3-1.0 kg of powdery preparation per hactare). MCPA (4-chloro-2-methylphenoxyacetic acid; @ 25-50 ltr of liquid preparation/ha), MCPB, MCPP etc. (Nickell 1981)and allied products can be used.

To conclude, it is urged that, to clearly ascertain the plant and animal interactions (Chakrabarty, 1991), and role of urban societies into these interactions, to have the guidelines for manoeuvering forest development in near future, an extensive research work has to be undertaken.

Acknowledgements

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SUMMARY

A number of grasses have been identified, which are highly preferred and consumed by the herbivorous fauna, in the Mahananda Wildlife Sanctuary and other wildlife reserves of North Bengal. On the contrary, the famous alluvial "Savannah" grasslands of this region have been found declining due to various interwoven factors. However, it has been found that, the larger varieties of grasses such as *Agrostis brachiata, Anthistiria gigantea* var. *arundinacea, Capillipedium assimile, Centotheca lappacea, Cymbopogon pendulens, Ischaemum aristatum* **sub. sp.** *imberbe* **Hack.,** *Panicum flvescence, Rottboelia exaltata, Saccharum arundinaceum* **var** *ciliaris, S. bengalensis, S. spontaneum* **L.,** *Setaria palmifolia* **etc., which are having underground, enormous, drought resistant rhizomes, are very suitable for plantation purposes and restoration of grasslands. The Savannah of Eastern sub-Himalayas, have been found to be of mixed type of vegetation from ecological point of view and therefore, mixed plantations have been recommended. Alternated patches of tree plantation with** *Dillenia pentagyna, Eugenia jambolana, Ficus* **sp. etc., are advisable. A copious growth of dicotyledonous weeds have been detected which should be eradicated to protect these invaluable Savannah grasslands.**

भारतीय अभयारणयों की चारा घासें I- उत्तरी बंगाल के महानन्दा और अन्य वन्य प्राणी अभयारण्यों के शाक भक्षियों द्वारा खाई जानेवाली घासों की पहचान

एस० बी० घोष

सारांश

बहुत सारी ऐसी घासों को पहचाना गया है जिन्हें उत्तरी बंगाल के महानन्दा वन्यप्राणी अभयारण्य तथा वहाँ बनाए अन्य वन्यप्राणी संरक्षित क्षेत्रों के शाक भक्षी पशु-पक्षियों द्वारा बहुत पसन्द करके खाया गया है ।इसके विपरीत, इसी क्षेत्र का प्रसिध्द जलोढ़ घासक्षेत्र परस्पर गुंथे हुए बहुत कारणों से पतनोंन्मुख पाया गया । तथापि यह पता लगा है कि बड़ी घासों की बहुत सी किस्में जैसे *एग्रोस्टिस ब्रैकियाटा*, *एंथीस्टायरिया जायगैण्टिआ* विभेद *अरूण्डिनेसिया*, *कैपिलिपीडियम एसिमिले*, *सेंटोथेका लैप्पेसिया*, *सिम्बोपोगोन पेण्डुलेंस*, *इशीमम एरिस्टेटम* उपजाति इम्बर्बे हैक०, *पैनिकम फलेविसेंस*, *रोट्ट्रटबोएलिया एक्जाल्टेटा*, *सैबकेरम अरूण्डिनेसियम* विभेद *सिल्लिएरिस*, *सै० बेंगालेंसिस*, *सै० स्पोंटेनियम* लि०, *सेटारिया पाल्मीफोलिया* आदि, जिनमें भूमि के अन्दर, विशाल, सूखा प्रतिरोधी शिफास्तम्भ होता है रोपवन लगाने और घास भूमियों को फिर से हरा-भरा करने के लिए बहुत उपयुक्त रहती हैं। पूर्वी उपहिमालयी क्षेत्र की घासभूमियाँ पारिस्थिकीय विचार से मिश्र प्रकार की वनस्पतियों वाली हैं और इसलिए उनके लिए मिश्र रोपवन लगाने की सिफारिश की गई है । बीच-बीच में एकान्तरित करके *डिल्लेनि पेंटागायना*, *युजीनिया जैम्बोलेना*, *फाइक्स* की जाति, आदि की वृक्ष पट्टियाँ लगाना अच्छा रहेगा । यहाँ पर बड़ी मात्रा में द्विबीजपत्रीय खरपतवार भी लगी देखी गई है जिसका उन्मूलन इन अमूल्य घासभूमि क्षेत्रों की रक्षा करने के लिए करना चाहिए ।

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OBSERVATIONS ON AVIFAUNA OF GREAT NICOBAR ISLAND, INDIA

KAILASH CHANDRA AND SANJEEV KUMAR

Zoological Survey of India, Port Blair (Andamans).

Introduction

Great Nicobar is the Southernmost and the largest Island of Nicobar archipelago. It is also the southernmost land piece of India and 145 km north of the northern tip of Sumatra. It lies between 6^0 45'N and 7^0 15'N latitudes and 93^0 38' and 93^0 55'E longitudes with an area about 1045 km^2. More than 85 per cent area (885 km^2) of the Island is under the Great Nicobar Biosphere Reserve and it is largest protected area in Andaman and Nicobar Islands. The Biosphere Reserve houses two National Parks viz. Campbell Bay National Park with an area of 426.23 km^2 and Galathea National Park with an area of 110 km^2. The Island is rugged with several hill ranges running from north to south direction with a highest known peak Mount Thuiller (670 m above sea level) situated in north-eastern side. The average rainfall of the island ranges from 300 cm to 330 cm and the relative humidity is rather high and usually remains 82% to 85% throughout the year. The climate of the island is tropical and vegetation predominantly of tropical evergreen rain forest type. The island has overwhelmingly phaenerophytic and typically broad leaved, multistoreyed, evergreen forests with some deciduous elements comprising of tall straight and buttressed trees with a close canopy formation.

The study

Although enough work has been carried out by the various workers like Abdulali (1981), Ali and Ripley (1968), Dasgupta (1976), Saha and Dasgupta (1980) and Tikader (1984) on the avifauna of Andaman and Nicobar Islands, but there is no island-wise comprehensive study on avifauna of these Islands, henceforth the present study was under taken. 71 species of birds belonging to 25 families representing 13 orders were observed from different localities and habitats of Great Nicobar Island. Authors feel that intensive survey of interior forests particularly in Campbell Bay National Park and Galathea National Park will yield many more interesting observations on avifauna of the Island. This survey was undertaken in January, 1993.

Acknowledgements

The authors are grateful to the Director, Zoological Survey of India, Calcutta and Officer-in-Charge of Zoological Survey of India, Port Blair, for providing necessary facilities to undertake the survey of Great Nicobar Islands. Thanks are also due to the party members for their invaluable assistance in the field.

List of Birds

Species	Natural Sighting	Occurrence
1	2	3
Phaethon lepturus Daudin	V	R
Ardea purpurea Linn.	I, II, VIII	C
Butorides striatus Linn.	I, VII	C
Ardeola grayii Skyes	VI	R
Bubulcus ibis Linn.	I, II, VI	C
Egretta intermedia Wagler	I, III	C
Egretta garzetta Linn.	I, II, III	R
Egretta sacra Gmelin	II, VIII	C
Nycticorax nycticorax Linn.	I, II, III	C
Ixobrychus cinnamomeus Gmelin	I, VIII	C
Ixobrychus sinensis Gmelin	I, II, VIII	C
Haliaeetus leucogaster Gmelin	I, IV	C
Spilornis cheela Latham	I, II, VIII	C
Spilornis klossi Richmond	VI, V	C
Megapodius freycinet Oberholser	VI, VII	C
Gallicrex cinerea Gmelin	VI	R
Pluvialis mominica P.L.S. Muller	I, II, IV, V	A
Charadrius leschenaultii Lesson	I, II, V	C
Charadrius mongolus Pallas	I, II, V	C
Numenius phaeopus Linn.	VIII	R
Numenius arguata Linn.	IV, V	R
Limosa lapponica Linn.	II, IV	C
Tringa totanus Linn.	IV	R
Tringa nebularia Gunnerus	IV, VII	C
Tringa terek Latham	II	R
Tringa hypoleucos Linn.	I, III, IV	C
Capella stenura Bonaparte	VIII	R
Calidris ruficollis Pallas	V	R
Calidris testaceus Pallas	II, IV, VIII	C
Limicola falcinellus Pontoppidan	I, III	R
Dromas ardeola Paykull	V	R
Sterna sumatrana Raffles	III, VIII	C
Sterna bengalensis Lesson	I, III, IV	C
Treron pompadora Gmelin	III, IV, V, VII	C
Ducula aenea Linn.	I, IV, V, VI	A
Ducula bicolor Scopoli	I, IV, V, VI	C
Columba palumboides Hume	I, VI, VIII	C
Macropygia rufipennis Blyth	III, IV, V,	C
Chalocophaps indica Linn.	IV	R
Caloenas nicobarica Linn.	I, IV, V, VI	C
Psittaculla caniceps Blyth	I, III, IV, VII	A
Psittacula longicauda Boddaert	IV,V,VII	A
Cuculus micropterus Gould	VII	VR
Chalcites maculatus Gmelin	IV	R
Eudynamys scolopacea Linn.	V	R
Otus scops Linn.	IV	VR
Collocalia esculenta Linn.	VIII	R
Alcedo atthis Linn.	IV, V, VII	C
Pelargopsis capensis Linn.	I, IV , VI	A
Halcyon pileata Boddaert	II	R
Halcyon chloris Boddaert	IV, V	C
Merops philippinus Linn.	III	VR
Pitta sordida Muller	VII	R
Hirundo rustica Linn.	VI	C
Lanius cristatus Linn.	II,VI,VIII	C
Oriolus chinensis Linn.	IV, VII	C
Dicrurus paradiseus Linn.	IV	C
Aplonis panayensis Scopoli	I, II, III	C
Acridotheres tristis Linn.	I, II, VI	C
Gracula religiosa Linn.	I, III, VI	C
Corvus macrohynchos Wagler.	I	R
Terpsiphone paradisi Linn.	I, III, VI,	C
Hypothymis azurea Boddaert.	II, III, VI	C
Cisticola juncidis Rafinesque	VI	R
Locustella lanceolata Temminck	VI	R
Phylloscopus tenellipes Swinhoe	VI	R
Zoothera citrina Latham	I, VI	A
Motacilla flava Linn.	I, VI, VII	C
Motacilla cinerea Tunstall	IV, VII	C
Nactarinia jugularis Linn.	I, VI	C
Aethopyga siparaja Raffles	II, VI	C

I = Campbell Bay, II = 14-16 km Northsouth Road, III = 34-36 km Northsouth Road, IV = Galathea Bay, V = Indira Point, VI = 8-10 km Eastwest Road, VII = 19-21 km Eastwest Road, VIII = Chengappa Bay.
A = Abundant, C = Common, R = Rare, VR = Very Rare

SUMMARY

The present paper reports the occurrence of 71 species of birds from different habitat zone of Great Nicobar Islands.

ग्रेट निकोबार द्वीप के पक्षिओं का अवलोकन

कैलाश चन्द्र व संजीव कुमार

सारांश

प्रस्तुत अभिपत्र में ग्रेट निकोबार द्वीप के विभिन्न प्राकृतिक आवास में पाये जाने वाले पक्षिओं की प्रजातिओं को रिपोर्ट किया गया है।

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From the Indian Forester - One Hundred Years Ago

THE INDIAN FORESTER

October, 1894 (pp. 380-381)

WATER AREAS IN RESERVED FOREST

It will be observed, that the conditions of Indian life, unlike those of Europe, necessitated our opening the Forest Act, with a provision for *constituting* the 'Forests' or areas which were to be subject to Forest Law. In Europe, these areas already were known and existing. Accordingly, the third Section of the Act of 1878 speaks of *land* in which Government has rights, &c., that would hardly justify us in taking up a lake *merely as such*, or an extent of river, or tidal water without reference to the Forest on either side. In the nature of things such a course could hardly be necessary. But if the water were not merely an area of water by itself, but could be regarded as part of an area of land, or as a natural feature of the land, which Government required to treat as forest, then, there is no doubt that the lake, river, tidal water &c. included in the boundary, would be part of the forest area, and subject to the Forest Law; if any rights to use after, to fish, etc., were claimed, they would be enquired into and settled under Chap. II. This is obvious from the term of Sec. 25, which refer to 'fishing,' 'poisoning water'and to rules made on the subject; such a provision could not be effective unless the enclosed river, lake, etc., were part of the forest and subject to the Forest Law.

I do not know what is meant by a "public right of way" to lake B situated in a reserved forest. If there were a public road leading to the lake, in would necessarily imply some right in the public to use the water of the lake in some way, and such a right should be defined and provided for by the settled arrangements of the Forest. And so if a private right of way existed fo the lake, it would, of necessity, imply that there was some right of using the lake, otherwise why is there a right of way to it?

It will be remembered that Government has a general right to the use and control (for public purposes) of all rivers, streams and lakes and 'natural collections' of water (Act VIII of 1873). This applies to Northern India and the Central Provinces, but there are similar laws elsewhere (see, for example, Bombay Act VII, of 1879, & especially Sec. 37 of the Bombay Land Revenue Code).

There can be no sort of doubt that a person, who had no right defined and recorded under Chap.II, to use water, or to fish inside a reserved forest and proceeding to do so, would be guilty of a civil trespass, and could be ejected, and further, if having no such right, his fishing ,&c. were in contravention of rules (Sec. 25 i) he would be liable to criminal prosecution. Sec 31, (j) makes the same principle applicable to the so-called "Protected Forest", only that there is the same doubt about rights that there is in every case owing to the general imperfection of procedure regarding the class of Forest.

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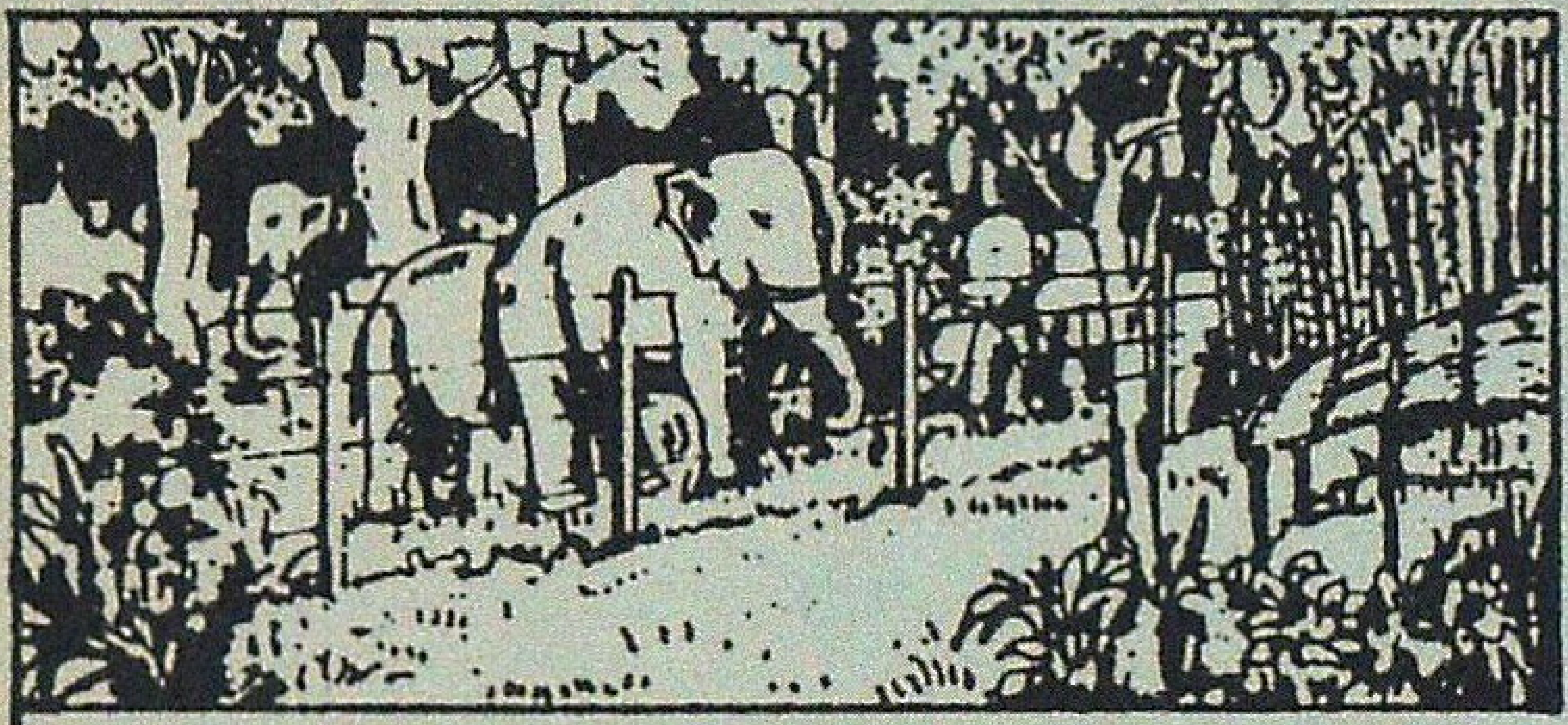

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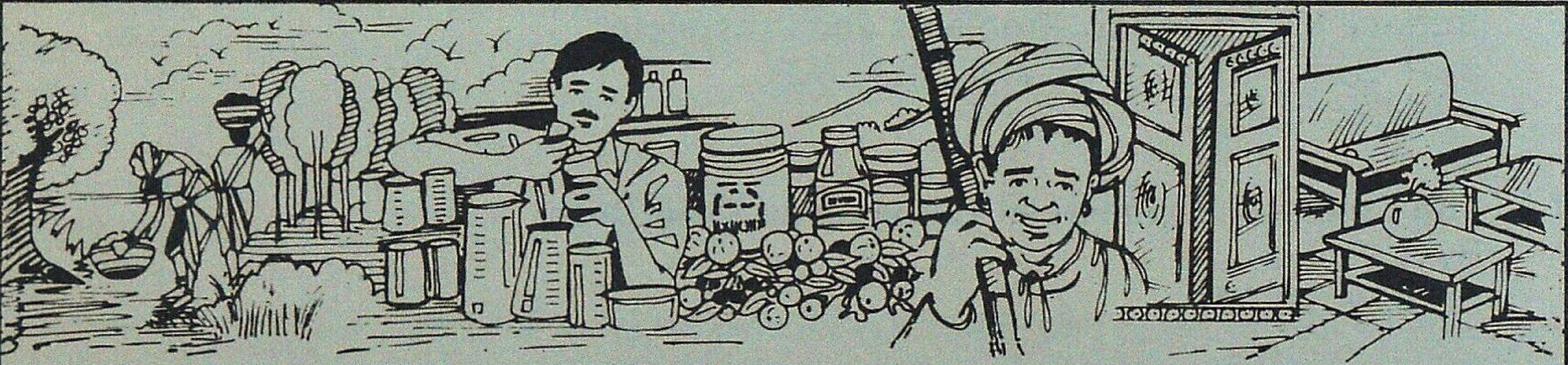

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* Corporation extracts high grade deodar, kail, chil, fir and spruce timber and resin by modern methods, produces ISI standard rosin (X to D grades) and non ISI 'B' grade and turpentine oil. All resin tapping has been done by Rill method during 1992 resin season and resin yield per section increased from 32 qtls. (1988 season) to over 41 qtls. (1992 season). Production of pale grades, registered improvement from 52% to 79%. There is no damage to the trees by Rill method.

* Large number of timber and fuelwood depots have been established at convenient location for the benefit of general public.

* In order to maximize operational efficiency, following steps have been initiated:

a) Financial data is analysed through computer net-work to ensure prompt and efficient working and decision making.

b) Providing incentives to officers and staff through prompt action on service matters like confirmation, job rotation vis-a-vis career planning including specialised training.

c) Centralisation of provident fund account of entire staff has been done through computer besides pay-bill centralisation.

* Inspite of meeting the social needs, it is a profit earning organisation.

B.S. Chauhan
Managing Director

KHANNA BANDHU

Ph : 621485

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OUR LATEST ARRIVALS ON FORESTRY

1. Management of India's Forest Resources - A.N. Chaturvedi
2. Technology of Forest Nurseries - A.N. Chaturvedi
3. Wild Life (Protection) Act - 1972 as amended up to date 1993 with commentry
4. Hand Book of Foresrty - L.S. Khanna

LIST OF OUR PUBLICATIONS

हिन्दी में

1. वनवर्धन - (Silviculture) एल० एस० खन्ना 'पुरस्कृत'
2. वन विज्ञान (वनवर्धन पद्धतियाँ, वन मापिकी तथा वन प्रबन्ध) 'पुरस्कृत'
   (Forestry - Silvicultural Systems, Forest Mensuration and Forest Management - एल० एस० खन्ना
3. वन उपयोग (Forest Utilization) एल० एस० खन्ना 'पुरस्कृत'
4. वन अभियान्त्रिकी (भवन निर्माण) - एल० एस० खन्ना 'पुरस्कृत'
   [Forest Engineering (Building Construction)]
5. भारतीय वन अधिनियम मीमासा - एल० एस० खन्ना 'पुरस्कृत'
   (Indian Forest Act - A critical study)
6. वन सर्वेक्षण (Forest Survey) - एल० एस० खन्ना 'पुरस्कृत'
7. वन मार्ग तथा पुल - एल० एस० खन्ना 'पुरस्कृत'
   (Forest Roads and Bridges)
8. वन रक्षण (Forest Protection) - एल० एस० खन्ना
9. वन्य-जीव संरक्षण तथा प्रबन्ध - एल० एस० खन्ना 'पुरस्कृत'
   (Wildlife Conservation and Management)
10. वन लेखा एवं प्रक्रिया - एल० एस० खन्ना
    (Forest Accounts and Procedure)
11. सौ उपयोगी वृक्षो का वनवर्धन - एल० एस० खन्ना
    (Silicultural of Hundred Useful Trees)

English

1. Principles and Practice of Silviculture. - L.S. Khanna
2. Forest Protection. - L.S. Khanna

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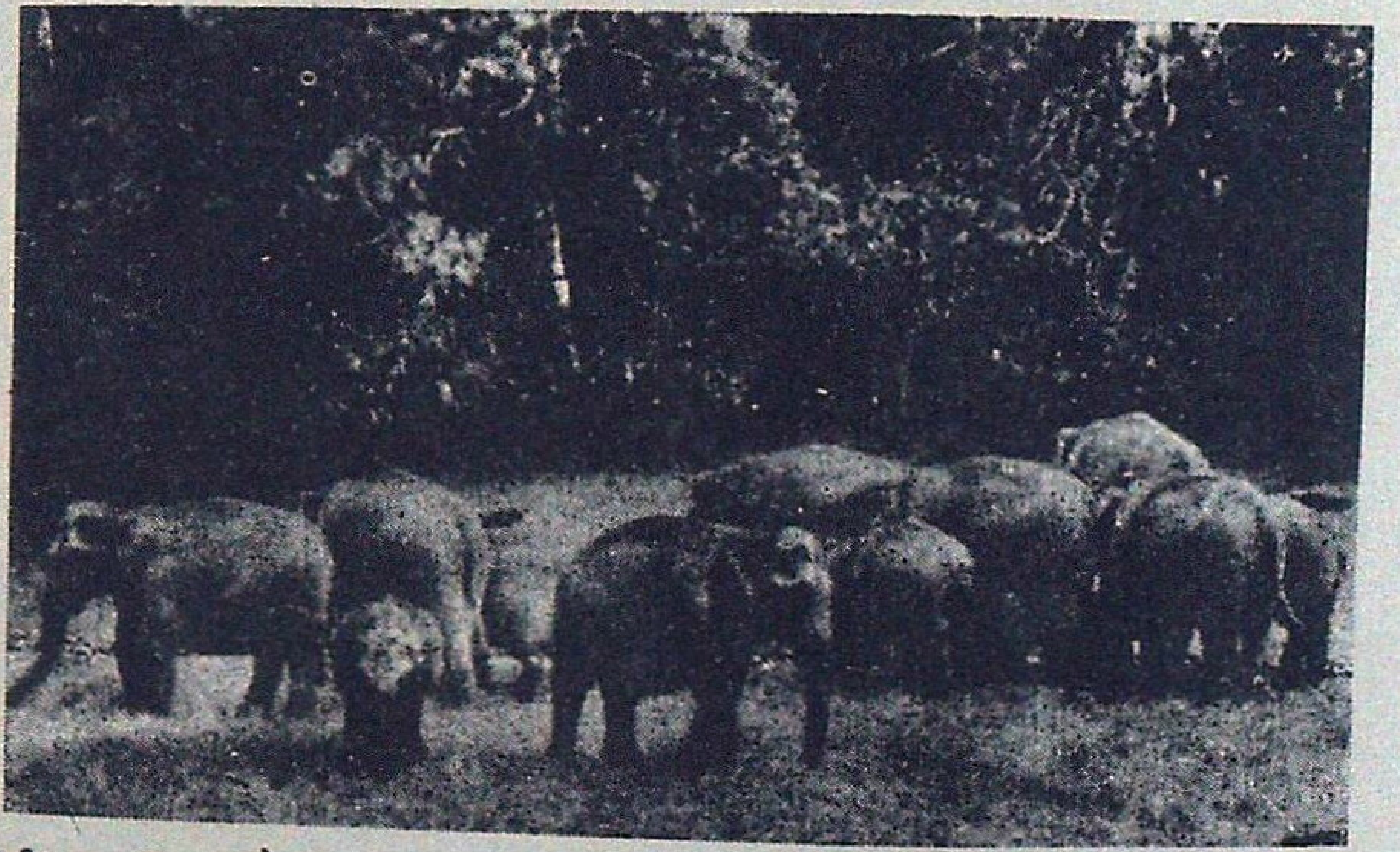

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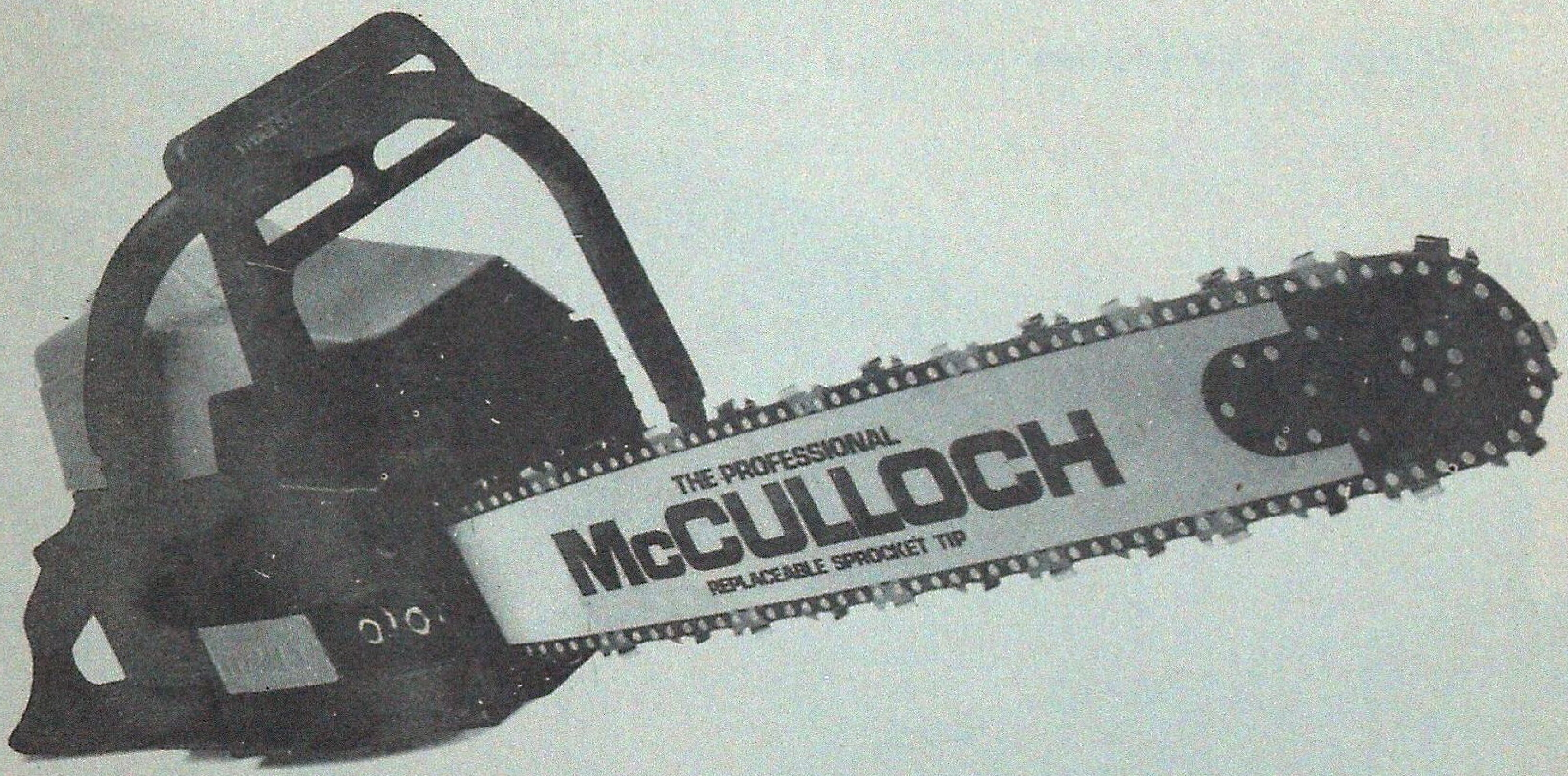

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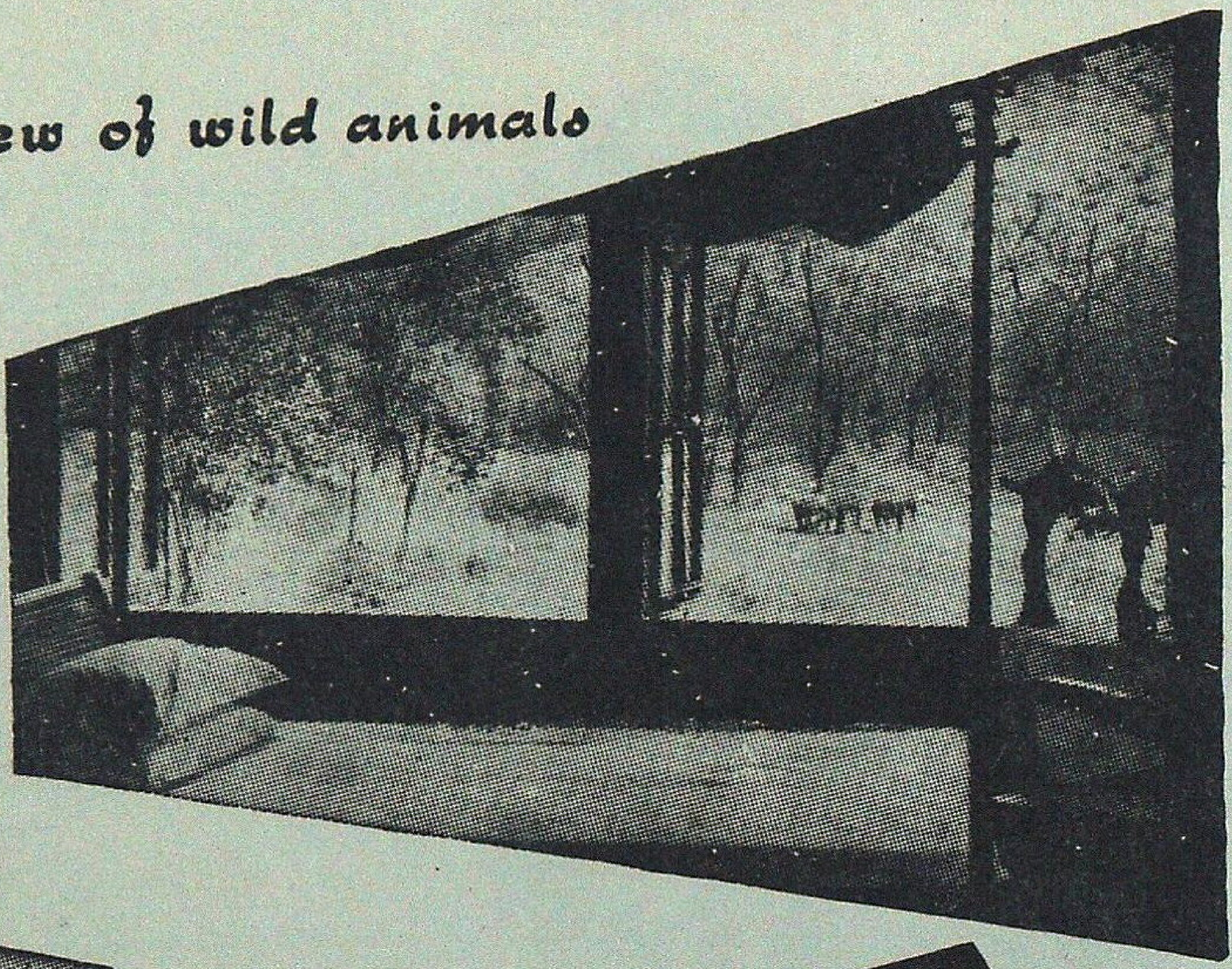

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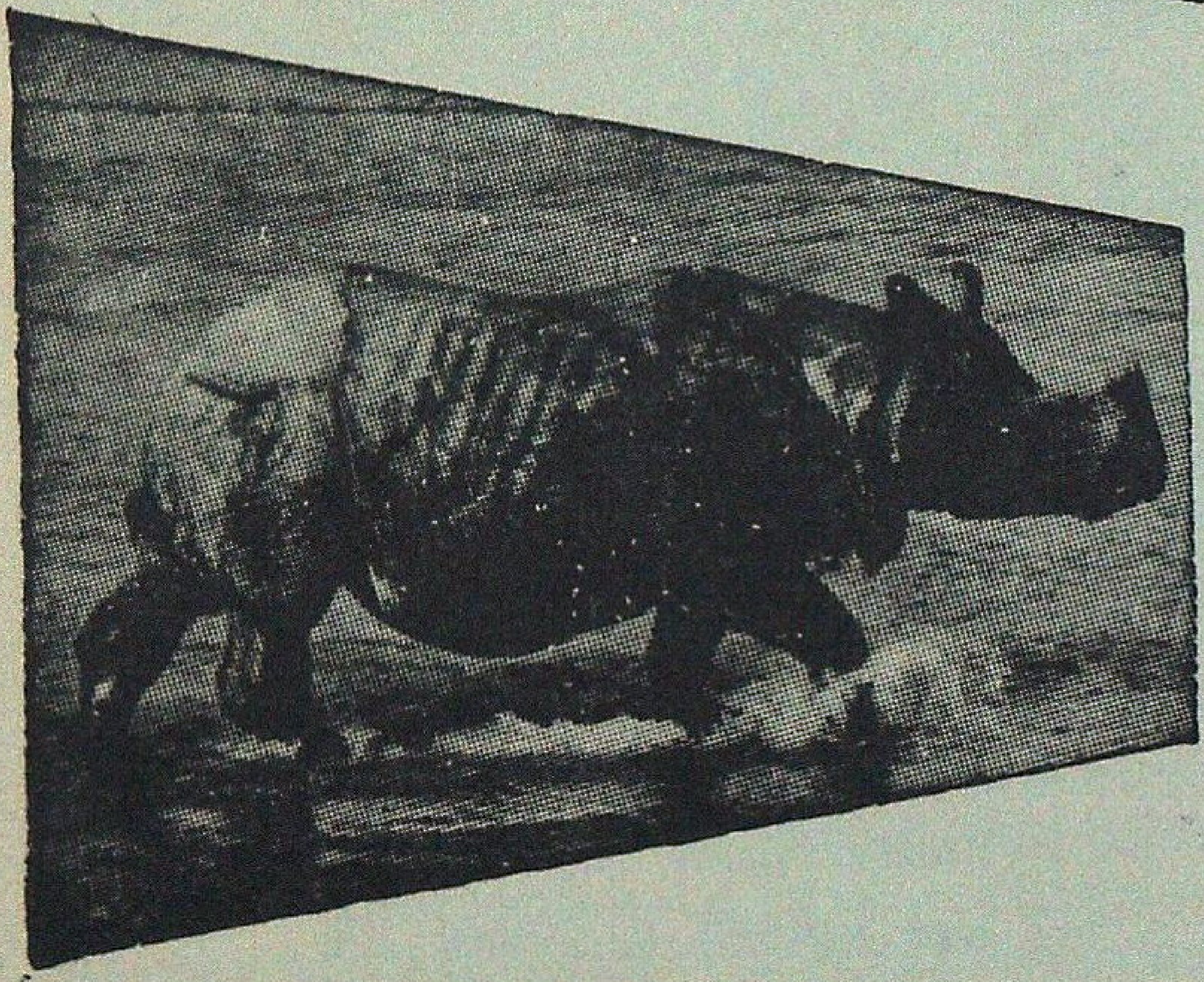

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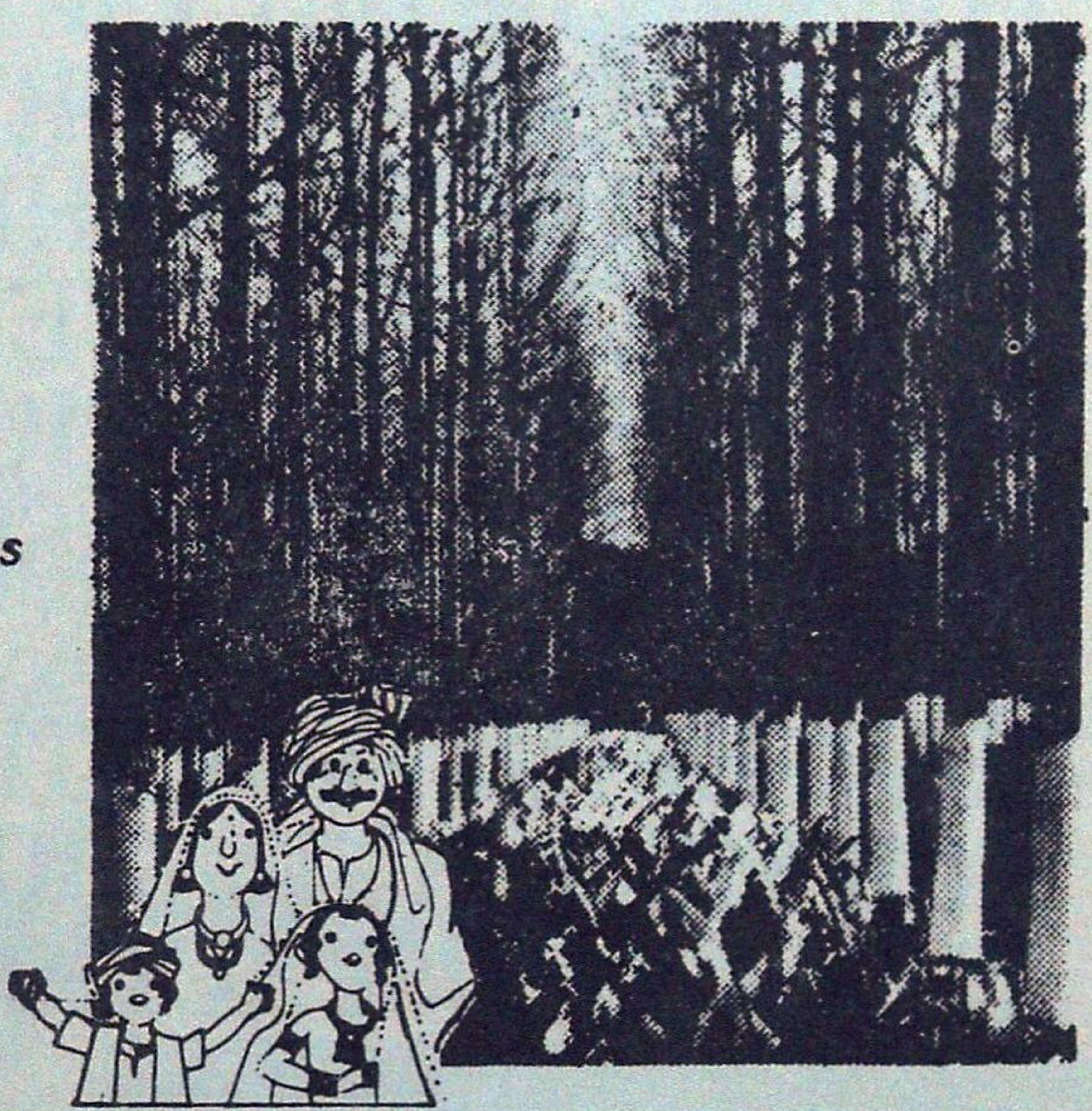

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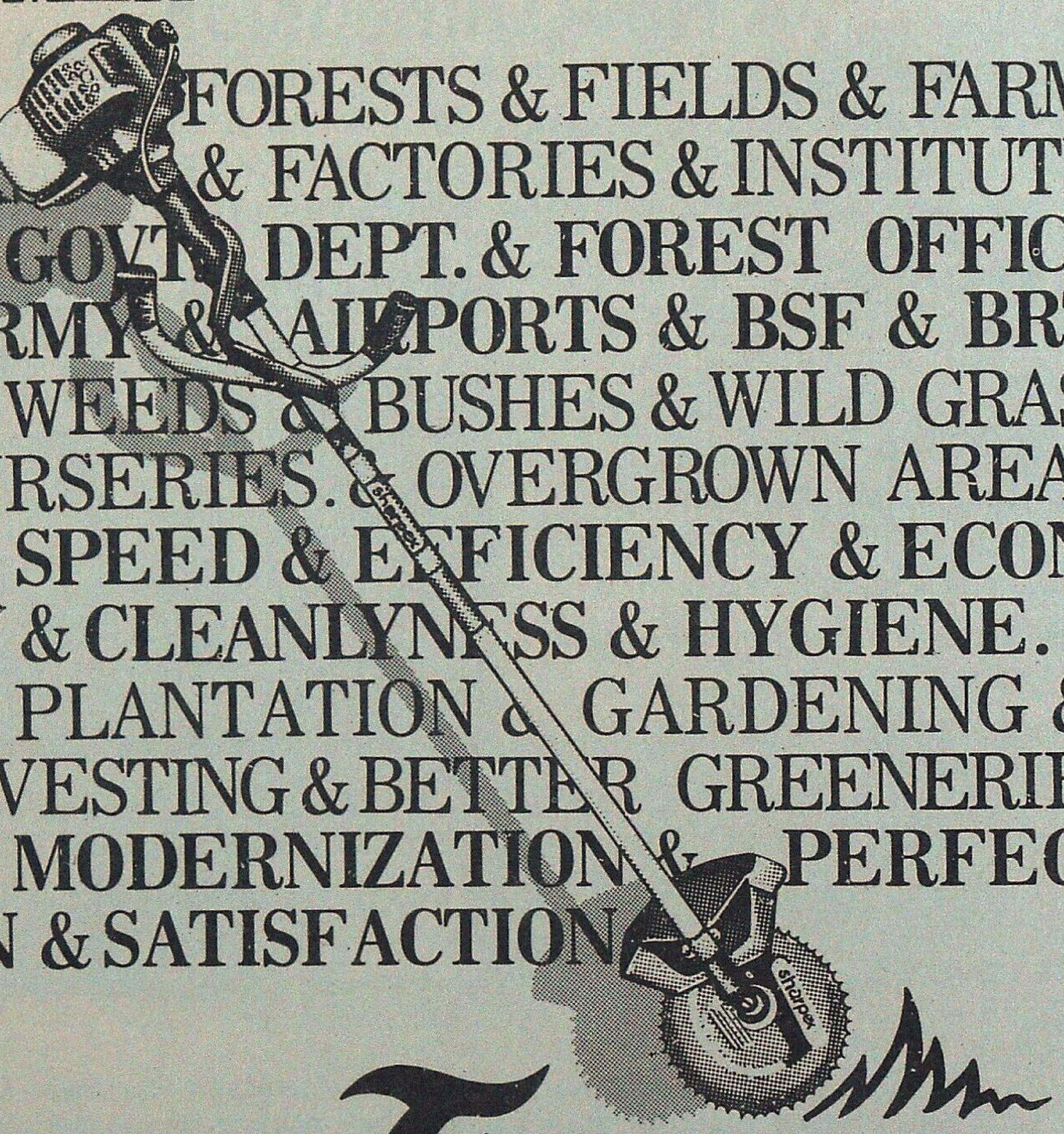

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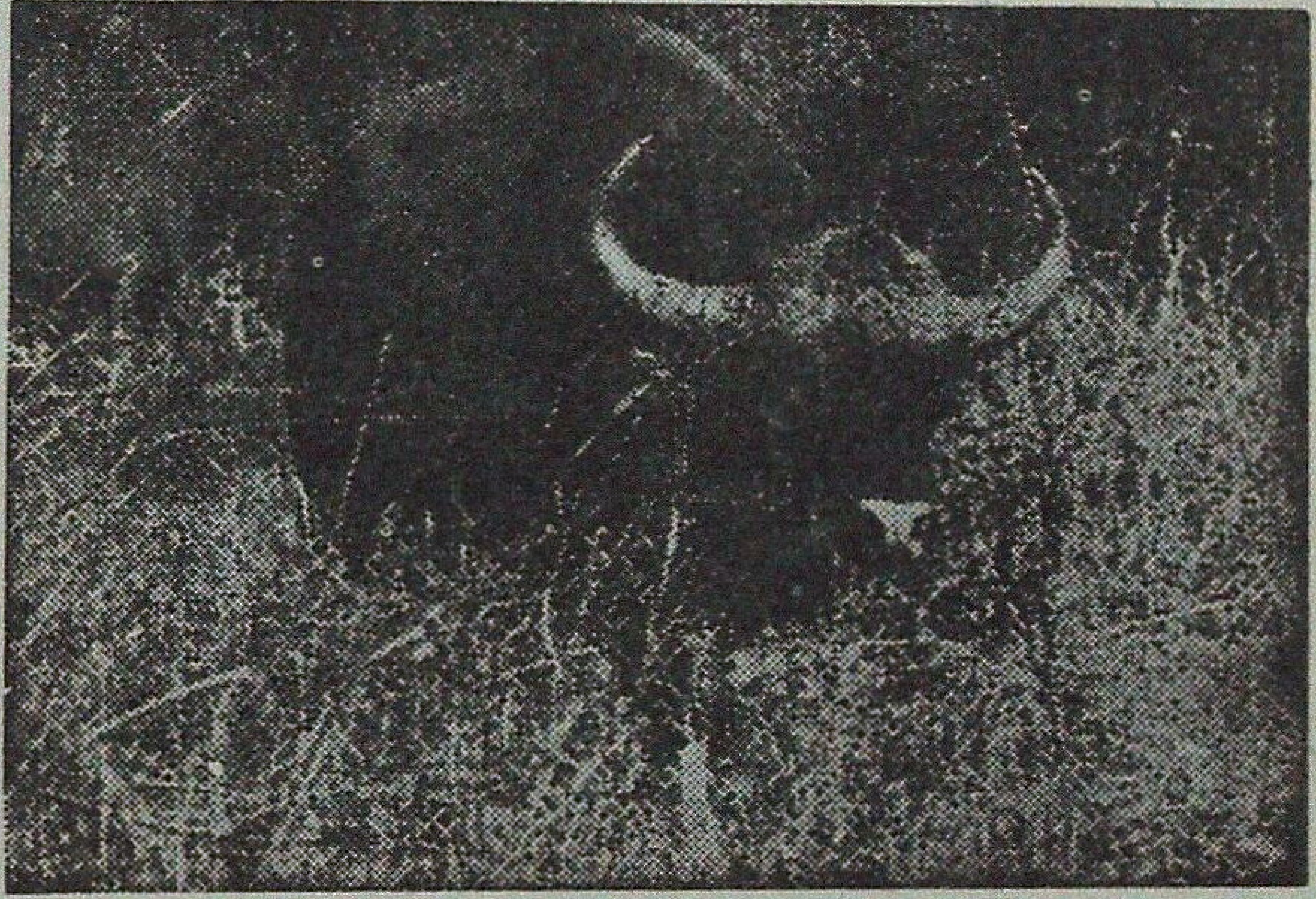

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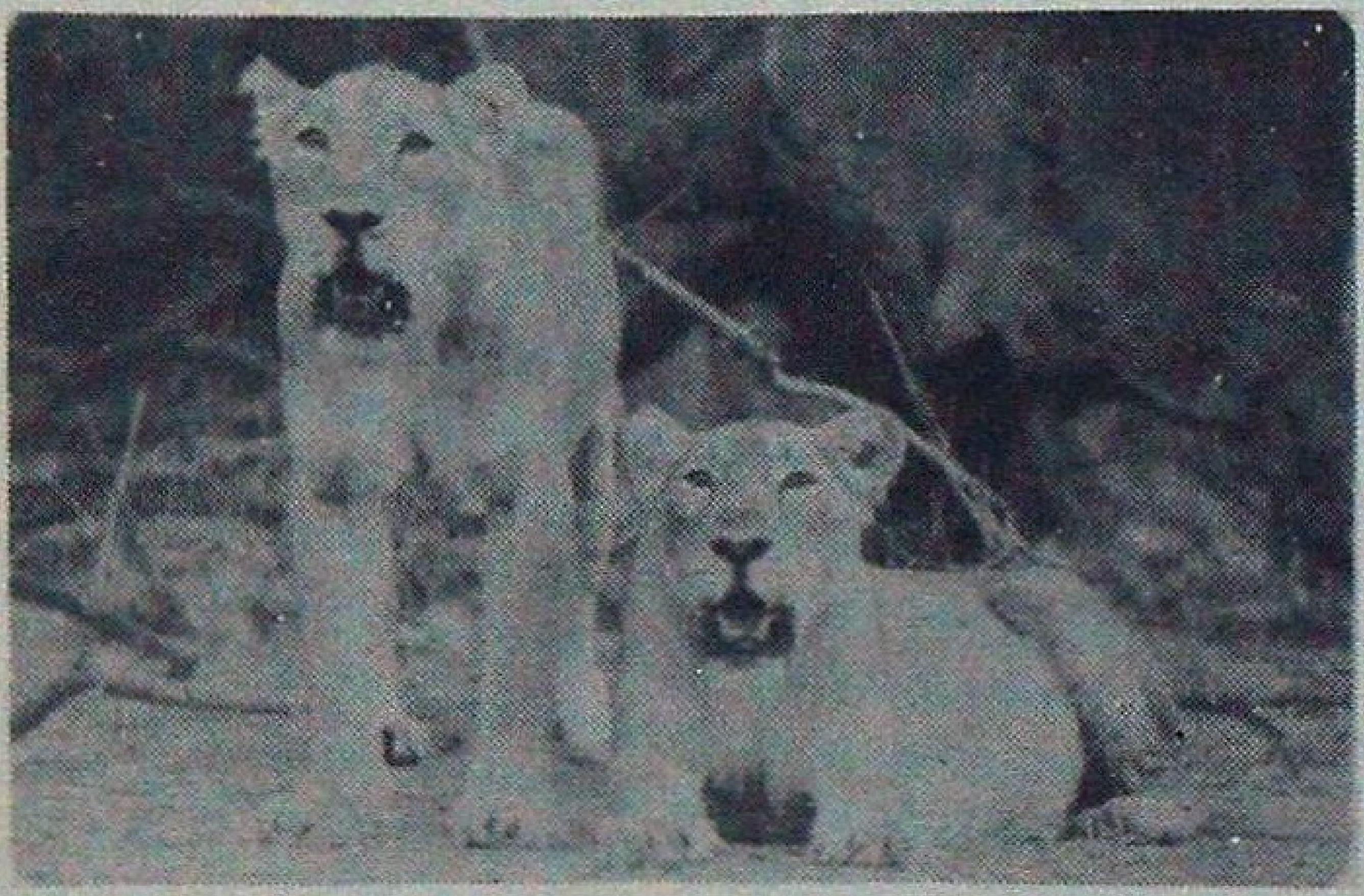

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33,781	हेक्टर क्षेत्र में बांस वृक्षारोपण
7,562	हेक्टर क्षेत्र में बिगड़े वनों का सुधार सह बांस रोपण
1,586	हेक्टर चीड़ रोपण
3,303	हेक्टर औद्योगिक वृक्षारोपण
49,915	हेक्टर क्षेत्र में सूखा उन्मुख क्षेत्र कार्यक्रम के अंतर्गत वनीकरण
334	रो कि0 मी0 पथ वृक्षारोपण
3,708	हेक्टर क्षेत्र में मिश्रित प्रजाति रोपण
33,830	हेक्टर क्षेत्र में चारागाह विकास
1,103	हेक्टर क्षेत्र में सबई रोपण
571	कि0 मी0 लंबाई में केतकी रोपण
3,833	हेक्टर क्षेत्र में लघु वनोपज योजना के अंतर्गत रोपण
3,136	हेक्टर क्षेत्र में वैकल्पिक वृक्षारोपण
115.13	लाख पौधों का पर्यावरण सुधार हेतु रोपण

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The Corporation completely appreciates the need for maintaining harmony with the nature and also realise that mere lip service is not at all enough for achieving this goal. Active research initiatives are on to find out new uses and thereby increasing the value of various produce namely seeds, fruits, bark, gums, leaves, etc. of the trees. Significant breakthroughs have already been achieved. The key premise is that assigning economic value to the non-timber uses of the entire range of trees available in the forest will promote the conservation of trees and forests.

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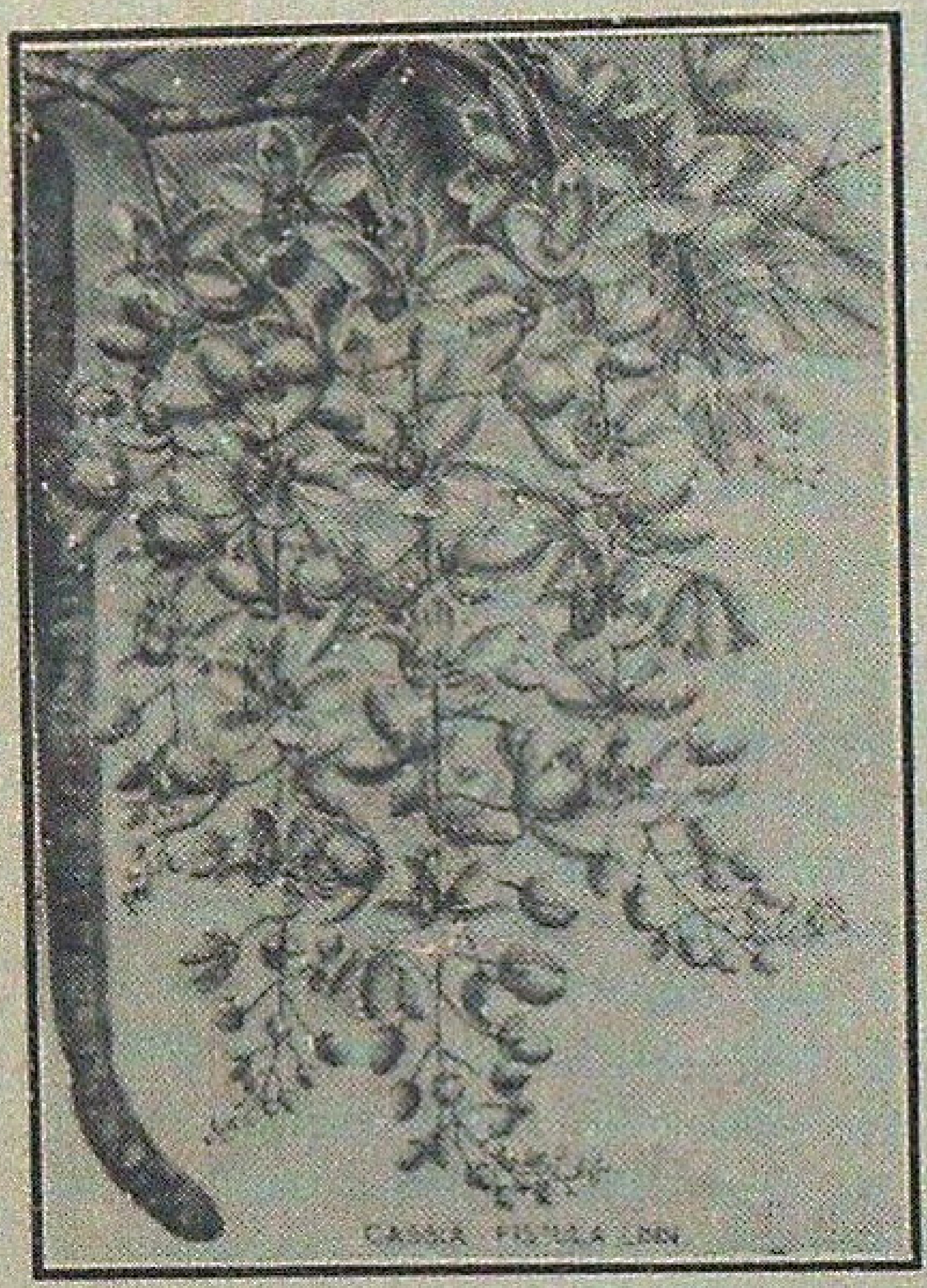
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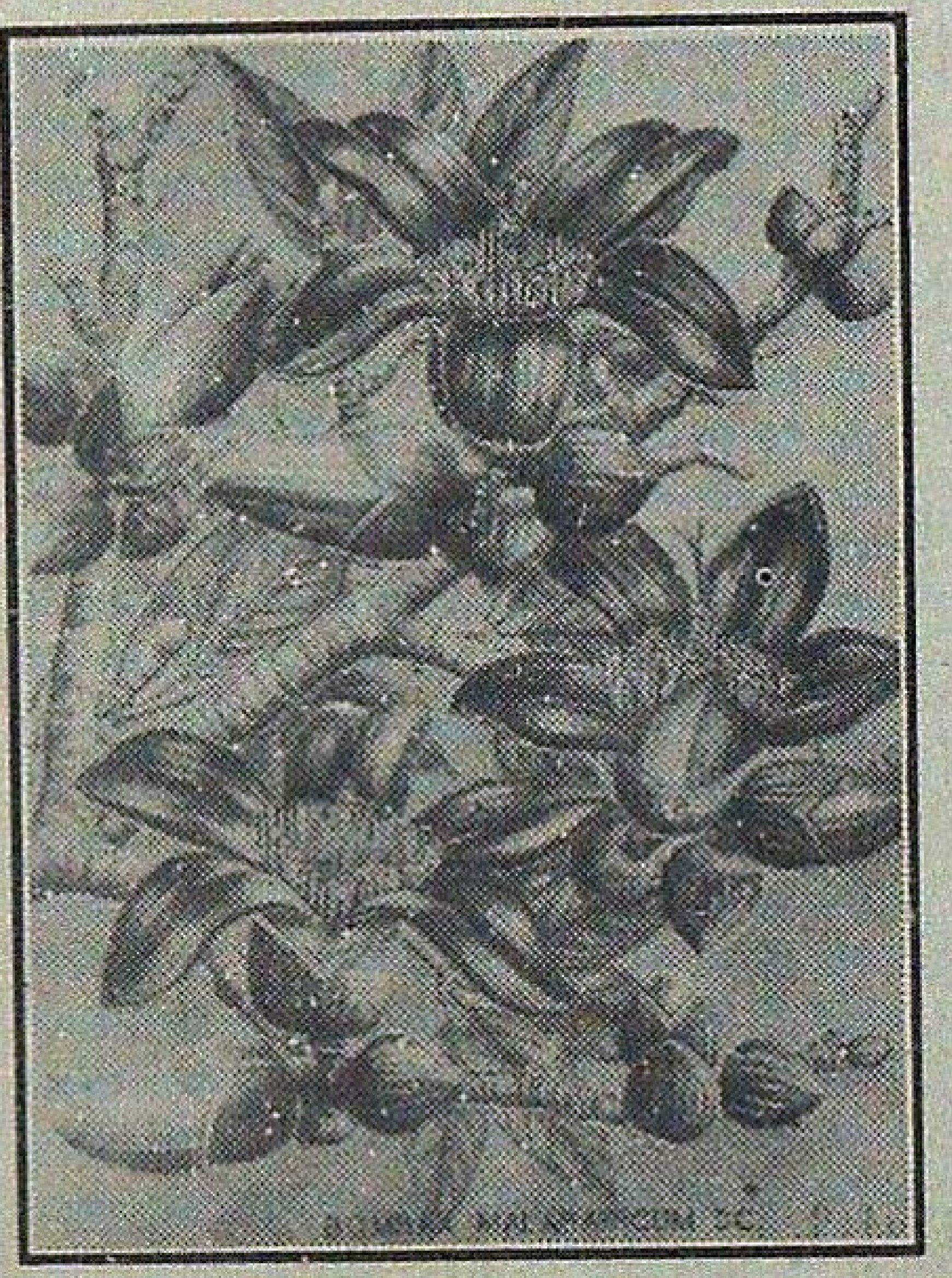
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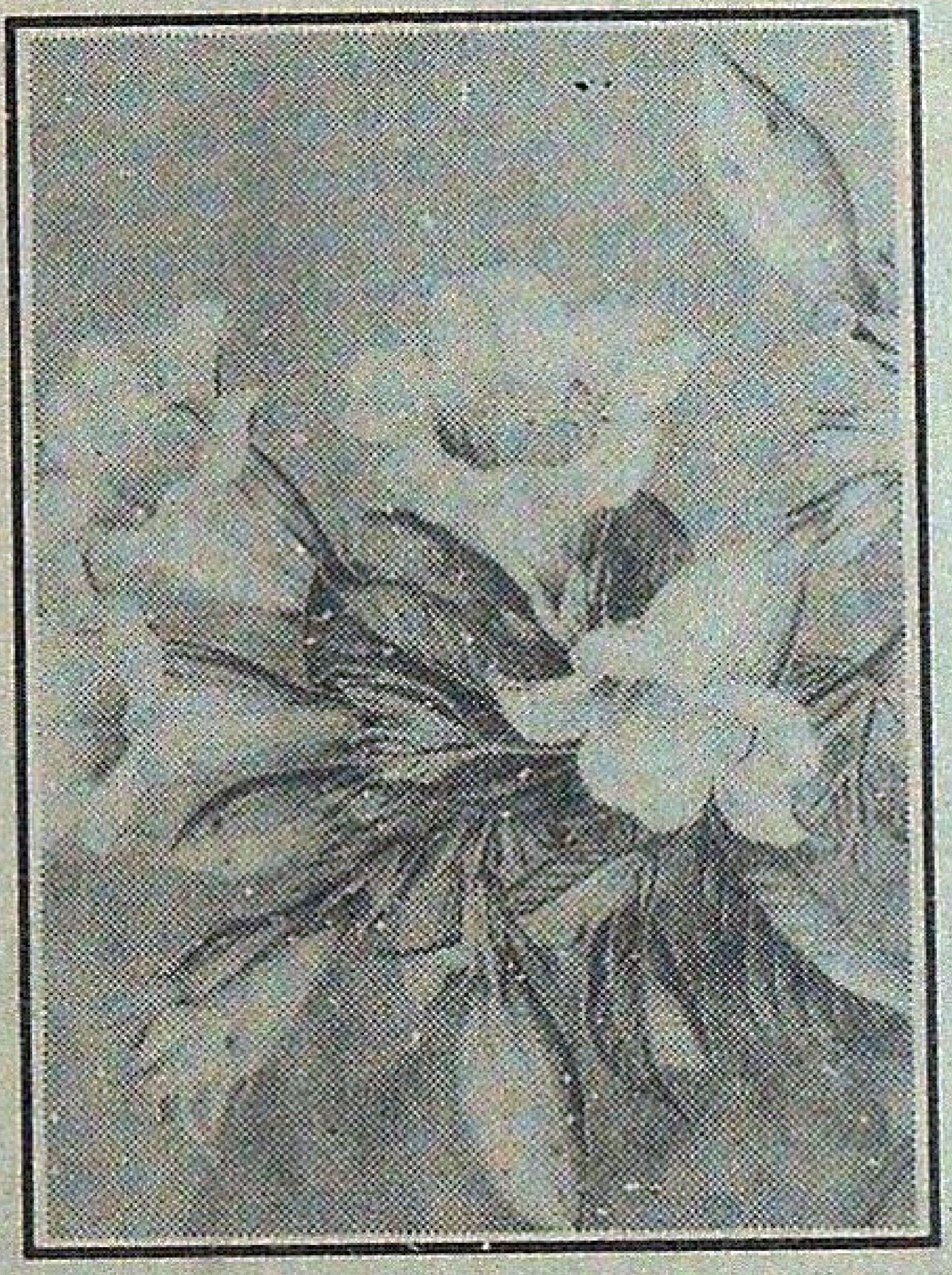

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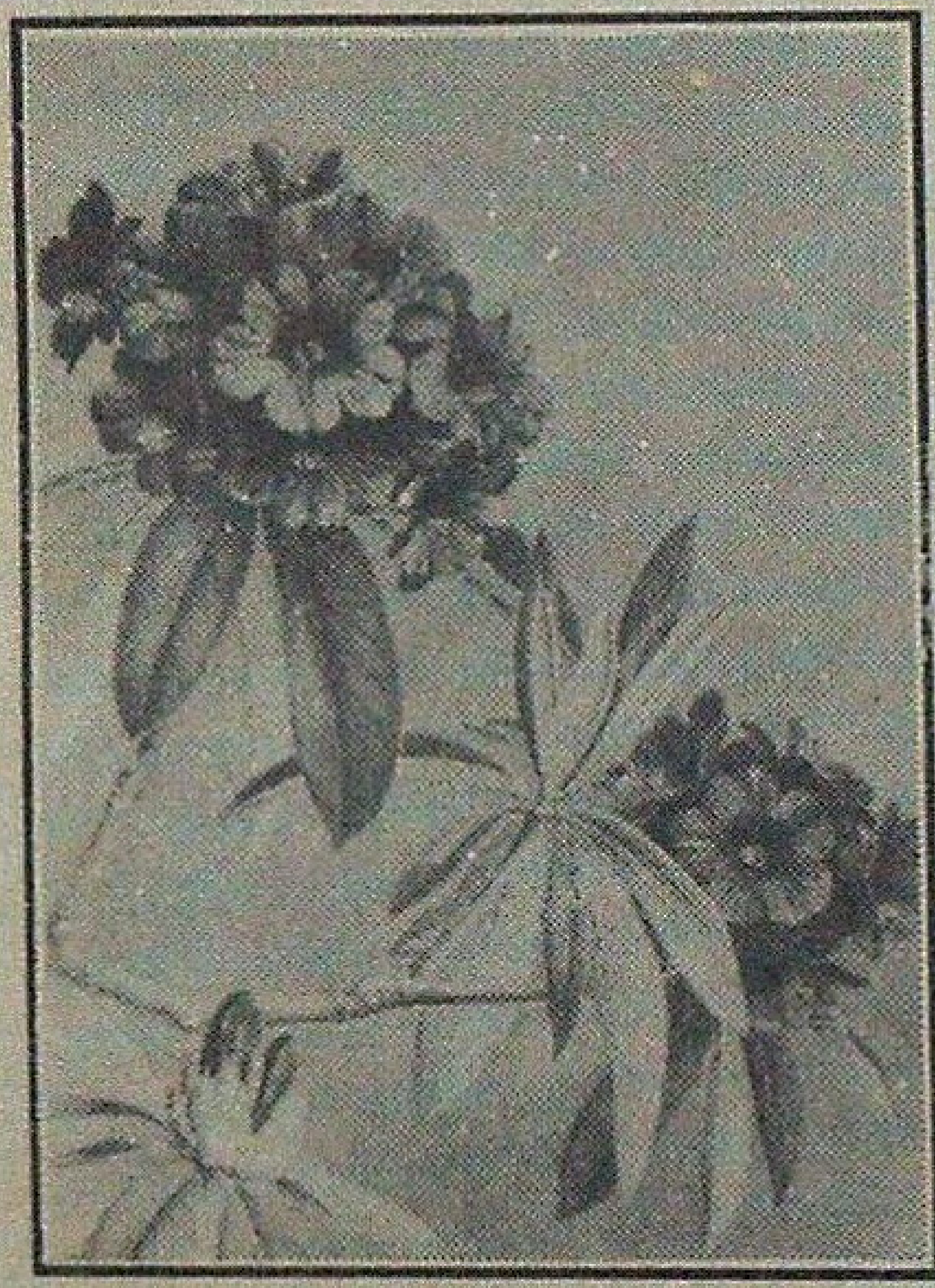

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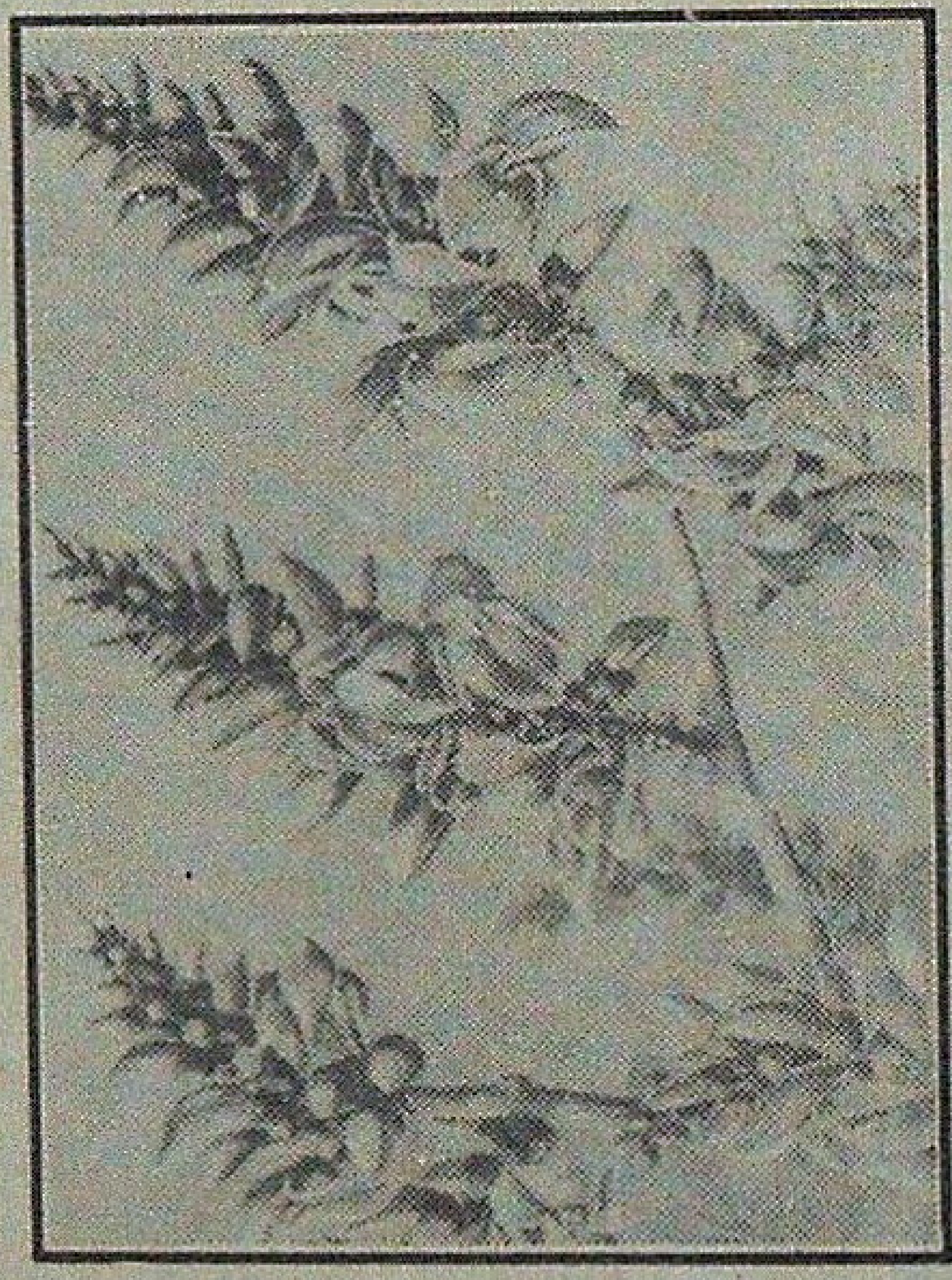

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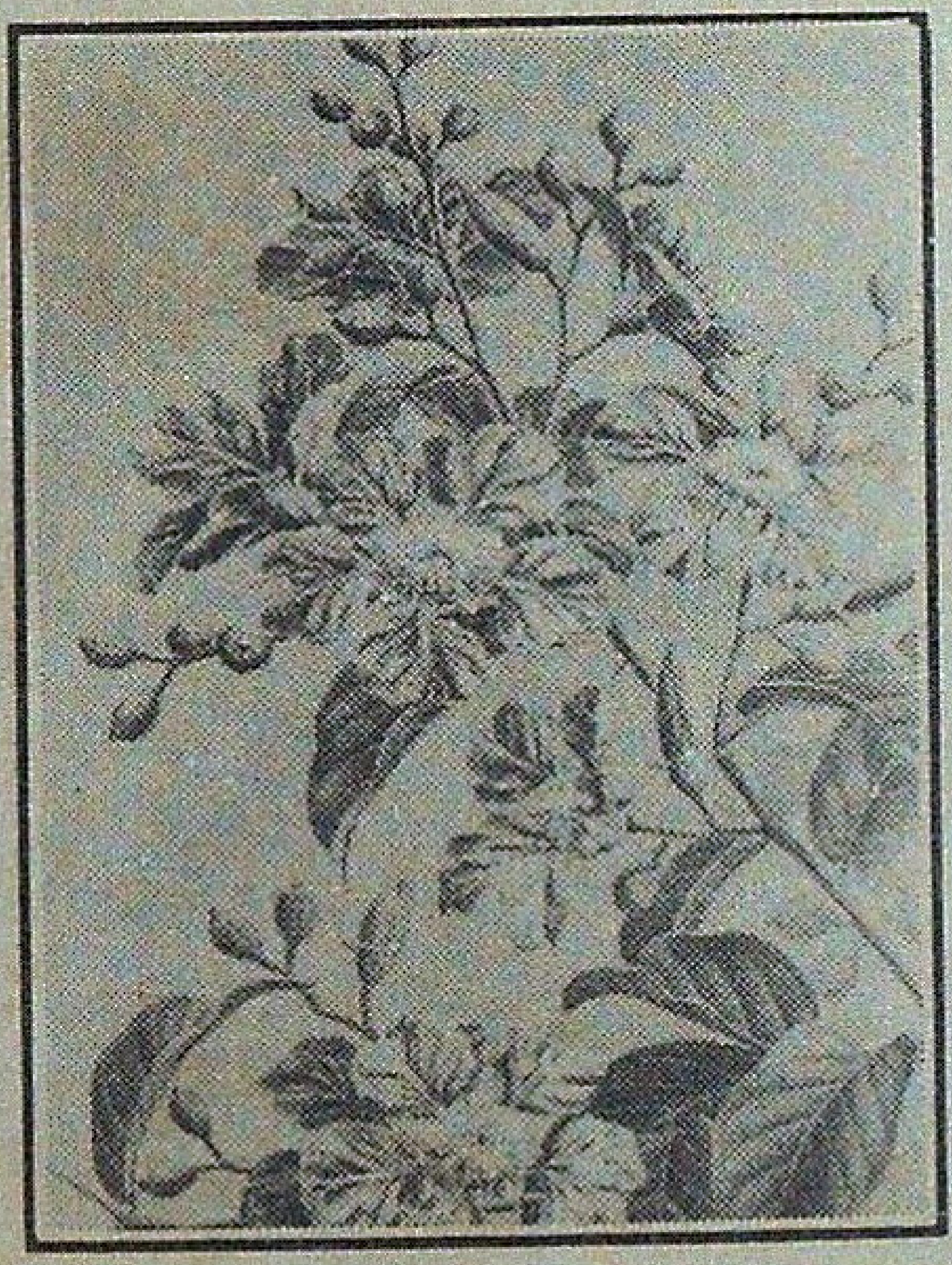

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